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Executive summary

This deliverable presents the Final Assessment of the observation and thematic networks as those represented in work package 3 of EuroSea, taking as a reference the information on Deliverable 3.2 Observing Network Initial Assessment. Following the same approach with D3.2 the original questionnaire was modified accordingly in order to depict the progress made on the same Network Attributes, Commitments and Benefits following the GOOS, OCG guidelines.

The unforeseen COVID-19 pandemic had significant effects upon WP3 activities since the main mechanism foreseen to advance progress within the different networks was the organization of in person workshops. Moreover, adequate funds were allocated towards this in order to promote inclusivity and participation. Adapting to the new situation the first series of workshops had to be changed into online only events which despite the inherent difficulty, proved to have significant advantages as well. In particular they gave the opportunity for a significant number of people to join from all around the globe and participate in the events (for example the Sea Level WS).

Another challenge proved to be the variability within some networks with sub-components or sub-groups having significantly different characteristics. In particular Eulerian platforms comprise a wide range of platforms - fixed moorings, surface buoys, cable bottom platforms - with some of them being part of mature and well-developed networks (OceanSITES, EMSO etc) while other are loose partners of on-going programs and projects (JERICO RI, coastal buoys).

EuroSea activities had a significant positive impact on all the observing and thematic networks, actively promoting synergies and collaboration, with most of them successfully reaching Framework Processes Readiness Criteria Level 7 and above. Although progress at many different aspects must continue beyond EuroSea, it is important that the framework has been set. It is thus suggested that an annual evaluation/assessment process for each network/task team is adopted within EuroGOOS. By going through this exercise annually, each EuroGOOS Task Team (observing network) will be able to describe its current state, assess progress and most importantly to define next targets and priorities.

1. Introduction

As stated in D3.2 which is a reference document for this Deliverable, the focus of WP3 is on two types of networks that operate today in Europe – the observing networks organized around a specific platform such as Gliders, Buoys, FerryBoxes etc. and those that have a thematic objective such as the Augmented observatories. The observing networks are grouped around a specific technology / platform such as profiling floats, underwater gliders, research and commercial vessels, fixed-point observatories, sea level gauges, HF radar and autonomous surface vehicles. To align with global efforts, in particular the GOOS Observing Coordination Group (OCG) and its networks, EuroGOOS, the European GOOS Regional Alliance (GRA), has established corresponding observational platform Task Teams[1] and Working Groups[2]. The EuroGOOS Task Teams are established to promote scientific and technological exchange and aim for synergies among

[1] https://eurogoos.eu/task-teams/
[2] https://eurogoos.eu/working-groups/

European nations ocean observation efforts that are structured around the various observation technologies. Task Team members exchange and collaborate in the areas of identifying shared priorities, developing and improving best practices, and aligning nations data management structures to improve the data delivery to EuroGOOS ROOS regional portals, EMODnet, and Copernicus Marine Service, mainly via the EuroGOOS Data Management, Exchange, and Quality Working Group (DATAMEQ WG) that has representatives from all Task Teams included.

Task Teams are also important operational components of the EOOS framework setting out a vision and coordination mechanisms for a truly integrated ocean observing in Europe, for the benefit of society, science and innovation. Within the EOOS framework the Task Teams work to:

- Coordinate the existing efforts of the individual observation communities;
- Provide an up to date picture of the reporting platforms in Europe;
- Facilitate development of common operational data procedures and services (incl. data quality control and data management);
- Foster scientific and technological development, joint programmes and concerted actions, enhancing the European marine infrastructure capacity.

Acknowledging that most European observing networks are designed to deliver towards certain issues aimed at particular stakeholders, but there is low level of integration between networks, delivering towards a wider range of users, a major EuroSea objective is to improve and integrate observing networks and the data flow by:

- Improving and enhancing the readiness and integration of observing networks, including thematic networks (augmented observatories) by supporting coordination and increasing the TRL of observing systems and tools and data delivery/management;
- Enabling FAIR data and facilitate integration of data by improving the data management structure and practices of the observing networks, and supporting ingestion of ocean data in the Copernicus Marine Service, EMODnet and SeaDataNet portfolios;
- Strengthening European visibility and leadership in international ocean observing efforts and foresight at an international level (such as GOOS and GCOS; in particular strengthening the European Ocean Observing System (EOOS) and contributing to the implementation of the Global Ocean Observing System (GOOS) 2030 Strategy.

Towards the above objectives (see also further details in D3.2[3]) the Framework Processes by Readiness Levels (RL), as outlined in the "Framework for Ocean Observing" (FOO; Lindstroem et al. 2012) and adapted by GOOS[4], was chosen as an appropriate method for examining the RL of the networks represented in WP3. The RL is divided into three main areas:

- **Requirement processes:** technological maturity, adequate sampling frequency, measurement precision and quality control, satisfaction of multiple user needs and ongoing international community support.
- **Coordination of observations elements:** Global and sustained observations, periodic review process, availability of specifications and documentation.

[3] https://doi.org/10.3289/eurosea_d3.2
[4] https://www.goosocean.org/index.php?option=com_content&view=article&id=20&Itemid=119

- **Data management and information products:** Standardized and interoperable data outputs, global availability of useful data, data management and distribution policies.

An RL scheme is then defined under each area that distinguishes three maturity levels (concept, pilot, mature) and this way enables an implementation and further development of components adapted to the respective RL. A timely implementation of components that are RL "mature", while encouraging innovation and research to improve lower RL. By further distinguishing each maturity level in three subgroups a total of nine RL is used in the FOO and presented in the initial assessment outlined in D3.2 (see for details).

What was chosen as a benchmark to allocate the RL is a set of network attributes that go back to what the GOOS Observing Coordination Group (OCG) group defined for the global networks (Network Attributes, Commitment and Benefits - What it means to be an OCG network) but slightly modified for European needs that are more defined than a global perspective can be.

For observational networks Eurosea WP3 (task 3.1-3.7) these attributes are

- Long term (>10 years) sustained observing needs are defined
- Coordination of a community of Best Practice around a specific technology
- Best Practices, addressing the EOV specification sheets, are documented and deposited at oceanbestpractices.org
- Open to all operators of the respective observing technology
- Improve internal coordination within the observational networks, guided by scientific/engineering expertise and supported by a technical coordinator
- Data policy is defined and comply with FAIR (findable, accessible, interoperable, re-usable) principles
- Specification and governance structure are articulated (e.g. Terms of Reference)

The above attributes formed the basis for the questionnaires sent to the EuroSea WP3 networks for the Initial (D3.2) and Final Assessments (this deliverable). The results are presented in section 3.

2. Expectations on the Networks during EuroSea

The WP3 objective in EuroSea was to improve integration of nations observations for "optimal" use in European (EuroGOOS) ocean observing initiatives and also to improve contributing to global initiatives (GOOS, GCOS). In this report what is defined as "improvement" is any increase in RL from the situation at the beginning of Eurosea, and documented in D3.2 (Initial Assessment), in comparison with the assessment done to create this deliverable. The aim of this report is to examine and document the areas that activities during the EuroSea project have had an impact considering the Framework Processes by Readiness Levels and the network attributes identified by the GOOS Observing Coordination Group (OCG) group.

A prominent characteristic detected in D3.2 was the difference levels of maturity across the various networks. These differences probably have historical reasons because some networks have been formed more than 20 years ago (e.g. Ferrybox was started in early 2002 through an EU project) while others took their very first steps within EuroSea (ASV group of interested operators). Likewise, the pathways the networks followed to consolidate are very individual. EU projects, COST actions or loosely connected

individuals formed the base for many of them. An important push for the consolidation was the respective task team framework in EuroGOOS that was established in 2015 and basically followed the approach for the

OCG for GOOS. However, the heterogeneity in the networks was evident and still is. Within EuroSea the networks identified different challenges as priorities for what they found critical to progress toward the WP3 overarching objective.

While details in the approaches had to be applied, various cross-cutting issues have been identified from the networks that can be grouped into four main categories (Table 1). It is worth mentioning that although coordination activities are included in all networks, integration is less frequent, denoting either the maturity of the network or the opposite, its immaturity, with priorities being focused on coordination and best practices.

Table 1. Overview of the four categories for improving operations of the networks during EuroSea

Network	Coordination	Best Practices	Integration	Data
Argo	✓	✓	✓	✓
Gliders	✓	✓	✓	
Vessels	✓	✓		✓
Fixed Platforms	✓	✓	✓	✓
Tide Gauges	✓	✓	✓	✓
HF-Radars	✓	✓		✓
ASV's	✓	✓	✓	

2.1. Argo

It is a mature network with the EuroArgo ERIC providing long term commitment of member states for funding and long-term time scale of activities. In the EuroGOOS Argo Task Team a major objective is to provide a platform also for the European countries that are not EuroArgo ERIC members. Also, the TT co-chairs are not EuroArgo ERIC members. In EuroSea the priorities have been in accordance with the recent advancements towards deep floats and biogeochemical sensors, focusing thus in formulating Best Practices. As shown below there were activities also on Coordination and Data while interoperability in the framework of EOOS was also examined.

Table 2. Argo development priorities in EuroSea

Coordination	✓
Best Practices	Biogeochemical (BGC) Deep > 2000m (DEEP)
Integration	Interoperability EOOS
Data	✓

2.2. Gliders

The EuroGOOS glider Task Team is well connected with the respective OCG network "OceanGliders". With support of EuroSea and the EU project GROMM II, and in conjunction with other nations under the

OceanGliders umbrella, a rather comprehensive and globally agreed collection of Best Practices on Operations and Data was created during the EuroSea. With a wide participation from glider operators all around Europe, coordination activities are a priority.

Table 3. Glider development priorities in EuroSea

Glider EuroGOOS Task Team / Ocean Gliders	
Coordination	EU Level – EuroGOOS/ROOSs
Best Practices	Operations Data
Integration	GOOS
Data	

2.3. Vessels – FerryBox and research vessels

Regarding vessels, in addition to the global coordination through the OCGs Ship-of-Opportunity Programme (SOOP) and Global Ocean Ship-based Hydrographic Investigations Program (GO-SHIP), the specific European ship coordination initiative "FerryBox" was established in Europe 20 years ago. Benefiting from EU funds, the network which later formed the corresponding EuroGOOS FerryBox Task Team can be considered as one of the most mature operational networks today in the EU with many achievements. A dedicated webpage with online tools for operators and data users, a real time inventory and best practice documents for the different parts of the system developed in cooperation with other EU project are some examples.

Table 4. Vessel development priorities in EuroSea

FerryBox EuroGOOS Task Team / GO-SHIP / SOOP JCOMM	
Coordination	Cost assessment, Evaluate/Assess technologies
Best Practices	Re-evaluate finalize
Integration	
Data	✓

2.4. Fixed Platforms

Although fixed platforms are the "oldest" platforms, due to the big variability in terms of technology and applications, networking has proved rather difficult despite the existence of the OceanSITES program of GOOS for deep water reference stations as early as 1999. In EuroSea activities spanned all four main categories.

Table 5. Fixed Platform development priorities in EuroSea

Fixed Platforms EuroGOOS Task Team / OceanSITES / DBCP WMO-IOC	
Coordination	✓
Best Practices	BP & QC procedures
Integration	Connection with global
Data	Harmonization metadata standards

2.5. Tide Gauges

EuroGOOS Tide Gauge Task Team is a European network of tide gauge platforms bringing together the tide gauge communities in the European and adjacent seas and acting as the European component in GLOSS (Global Sea Level Observing System). It compiles information on existing sea level networks at national level, and assists its members with operational requirements, such as standardization of tide gauge operations, data quality control and processing and applications of multi-purpose networks. In addition to improvements on Best Practices efforts during EuroSea have focused in the development of a Tide Gauge Metadata Inventory designed to address inconsistencies and omissions in metadata across European tide gauge data portals, enabling tide gauge operators to populate a single centralised tide gauge inventory with comprehensive metadata, which can then be accessed by data portals and data aggregators to standardise their own metadata records.

Table 6. Tide gauges development priorities in EuroSea

Tide Gauge EuroGOOS Task Team / GLOSS	
Coordination	✓
Best Practices	Improvements - Auto QC - Processing techniques
Integration	
Data	Recommendations on Data Flow

2.6. HF-Radars

Coordination of European HFR activities is at the center of the EuroGOOS HFR Task Team with significant contributions to the wider community (through the connections with the Global HF Radar network) such as best practices, definition of data standards and quality assurance etc. In addition to these, within EuroSea particular effort was invested on governance and the formulation of a new governance strategy.

Table 7. HF-Radars development priorities in EuroSea

HFRadar EuroGOOS Task Team / Global HF Radar Network	
Coordination	✓
Best Practices	✓
Integration	Develop - Tools for QC - Products
Data	NRT Data MGT

2.7. Autonomous Surface Vehicles

Considering that Autonomous Surface Vehicles (ASV) are of increasing importance for multiple observing objectives at the air/sea interface and in the near surface ocean, EuroSea laid the foundations for the establishment of a European Network. The wide range of ASV technology solutions available and already in use, demand coordination actions at the initial steps of the application of the specific technology promoting knowledge exchange on operational aspects and protocols, data (QC, formats, storage and access), risk assessment and legislation among others.

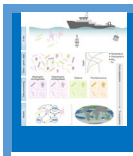
Table 8. Autonomous Surface Vehicle development priorities in EuroSea

 	
Coordination	Network Definitions
Best Practices	SOPs
Integration	ToRs
Data	

2.8. Augmented Observatories

This thematic network is at its infancy and as a result all four main activities are relevant at this early stage. In addition to formulating SOPs and Best Practices a related EuroGOOS Working Group has been established - Biological Observations Working Group (BIOWG) – with the aim to achieve a cultural change in biological observation from individual efforts into an integrated, and coordinated European effort with global impact to further our understanding of life in the ocean and how it interacts with and influences the environment. Liaising with the Biological and Ecosystems EOV Panel (GOOS) and the EBV development groups (GEO BON) towards the endorsement of SOPs by targeting specific EVs is foreseen.

Table 9. Augmented Observatories development priorities in EuroSea

	
Coordination	✓
Best Practices	Develop, Implement, Disseminate OMICS SOPs
Integration	Align to GOOS EOVs, Shape International Standards
Data	

2.9. Interface with in-situ data integrators

Although not a strictly thematic network a prominent activity has been the interface with in situ data integrators including a close collaboration with the observing network operators and data managers to ingest ocean data in the CMEMS and EMODnet products with an acceptable level of metadata and homogeneous quality. The main objective is to ensure that EuroSea new or consolidated data sets (physics, biogeochemistry) will be ingested in the Copernicus Marine Service and EMODnet portfolios as an essential step to make sure data feed Copernicus modelling and data assimilation systems, downstream coastal forecasting systems and EOV assessment.

Table 10. Interface with in-situ integrators development priorities in EuroSea

	
Coordination	
Best Practices	
Integration	
Data	Ingestion of (meta) data at national/PI level - CMEMS - EMODnet - SeaDataNet

3. Evolution of Networks during EuroSea

The final assessment of the two network types was based on a similar list of topics with the initial questionnaire. Through a questionnaire that was provided to the tasks of WP3, information was acquired. Moreover, information was added by considering information on the OCG observational networks from their respective websites (see also website links given in the table under subsections 3.1 and 3.2). The list of topics for each type of networks are given below:

Observational network topics

- Internal organization
  - Website
  - Institutions (incl. outside Europe)
  - Terms of Reference (ToR)
  - Governance structure established and documented
  - Self-assessment on representing of the respective European observing efforts via the network
  - Linkages to the global observational networks
- Network Internal Performance and Targets
  - Sensor/Instrument/Hardware Best Practices availability
  - Data Quality Assurance (QA) and Control (QC) strategies
  - International Standards compliance
  - Exchange of metadata and data with European data centers
- Visibility of the network
  - Best Practice Documentation accessibility
  - Key performance indicators (definition and monitoring)
  - Data availability on Global Telecommunication System (GTS)
  - Data policy
- Coverage and Facilities
  - Observing Requirements
  - Primary drivers for the observational activities
  - Dialogue with “thematic networks”
- Future aspirations
  - Practices in developing future operations
  - Where do you see your network in 2030?
  - Major challenges and opportunities for the operation of future operations
- EuroSea Activities
  - Task objectives
  - Observational networks cross cutting activities
  - Biggest achievements within EuroSea

Thematic networks topics

- Internal Organization
  - Website

- Institutions involved
  - Terms of Reference
  - Governance Structure
  - Embedding the operations into European observing initiatives
  - Embedding in global observing thematic initiatives
- Network internal performance, Targets
  - Number of science cases covered by the thematic network and respective documentation
  - Data Requirements document (incl. link to the relevant Best Practices/SOP)
  - Considering international standards (when possible)
- Visibility of the thematic network
  - Link to EuroSea observational networks (Task 3.1-3.7)
  - Link to international observational networks (Argo, GO-SHIP, GLOSS, …)
  - Link to international or even global thematic networks (if exists)
- Coverage and Facilities
  - Coverage of thematic network applications
  - Dialogue with “observational networks”
- Future aspirations
  - Practices in developing future operations
  - Major challenges and opportunities for future operations

3.1. Observational network topics

Internal organization

Website

Table 11. Network visibility with progress during EuroSea

Network	Global Website 1	European Website 2	Metadata access Website 3	Progress in EuroSea
Argo	http://www.argo.net	https://www.euro-argo.eu/	https://www.oceanops.org/board?t=argo	https://eurogoos.eu/eurogoos-argo-task-team/
Gliders	https://www.oceangliders.org	https://www.ego-network.org	http://www.oceanops.org/board?t=oceangliders	https://eurogoos.eu/gliders-task-team/
Vessels	https://www.go-ship.org/	http://eurogoos.eu/ferrybox-task-team	http://www.oceanops.org/board?t=sot http://www.oceanops.org/board?t=go-ship	https://eurogo-ship.eu/
Eulerian	www.oceansites.org	http://eurogoos.eu/emso-task-team/	https://tinyurl.com/yy9v56mu http://www.oceanops.org/board?t=dbcp	

Network	Global Website 1	European Website 2	Metadata access Website 3	Progress in EuroSea
Sea Level	https://www.gloss-sealevel.org/ real time: https://www.ioc-sealevelmonitoring.org/, fast delivery centre: https://uhslc.soest.hawaii.edu/, delayed mode: https://www.bodc.ac.uk/, mean sea levels: https://psmsl.org/ and GNSS data at tide gauges: https://www.sonel.org/)	http://eurogoos.eu/tide-gauge-task-team	https://www.ocean-ops.org/board?t=gloss	http://eurogoos.eu/tide-gauge-task-team
HF-Radar	http://global-hfradar.org/	http://eurogoos.eu/high-frequency-radar-task-team/	http://global-hfradar.org/	https://rucool.marine.rutgers.edu/geohfr/index.html
ASV	http://www.oceanops.org/dbcp/overview/evaluation_usv.html		Via DBCP https://tinyurl.com/y635eptm	https://eurogoos.eu/gliders-task-team/

At the end of the project we see that all networks are accessible on the network through the EuroGOOS website which is definitely an advantage considering the homogeneity and that visitors can access networks through a one stop shop. Moreover, all networks are visible on various other Global and/or National websites, including websites for Metadata Access.

Institutions Involved (incl. outside Europe)

The following table shows the participation per European country. The table is compiled from input to the survey and investigations from the GOOS networks that fall under the OCG umbrella and report metadata to www.OceanOPS.org.

Table 12. Participation (yellow colour) of national institutions into observing networks. Red colour indicates withdrawal. For the Eulerian (x) indicates EMSO members while red color denotes addition or withdrawal.

Country	Argo	Underwater Gliders	Research (R) & Commercial Vessels (c)	Sea Level	Eulerian (EMSO x)	HF-Radar (x: new systems connected to NODE during Eurosea)	ASV
Albania							
Belgium							
Bosnia							
Bulgaria							
Croatia							
Cyprus							
Denmark							
Estonia			c				
Faroes							
Finland			c				
France			R		x	x	
Germany			R, c				
Greece			R, c		x		
Iceland							
Ireland					x		
Italy					x	x	
Latvia							
Lithuania							
Malta						x	
Monaco							

Country	Argo	Underwater Gliders	Research (R) & Commercial Vessels (c)	Sea Level	Eulerian (EMSO x)	HF-Radar (x: new systems connected to NODE during Eurosea)	ASV
Montenegro							
Netherlands			c				
Norway			c			x	
Poland							
Portugal			c		x		
Romania					x		
Russia							
Slovenia						x	
Spain					x	x	
Sweden			c				
Turkey							
Ukraine							
United Kingdom					x		
TOTAL	**12+1**	**13**	**31**	**27**	**11 (8-1)**	**15**	**9**

In the framework of EuroSea, Denmark joined Argo (red mark) while the UK left EMSO ERIC (red x). From a quick look it is obvious that Research and Commercial vessels together with the Tide Gauges constitute the most popular platforms, while ASV's are the least spread as expected. It is worth noting that from the 33 countries on the table only 10 of them seem to have adopted a multiplatform strategy.

Terms of Reference (ToR)

Table 13. Observing network ToRs with links and progress during EuroSea

Network	ToR	Document	Progress in EuroSea
Argo	Yes	https://www.euro-argo.eu/About-us/The-Research-Infrastructure/Statutes	A change of scope of the Argo Task Team of EuroGOOS was initiated in 2021. New Terms of Reference for the Task Team have been endorsed by EuroGOOS governance late 2022. This change of scope includes better articulation between the Task Team and the Euro-Argo Management Board, and emphasis on the role of the Task Team in facilitating the collaboration between Euro-Argo and its potential new members. The new Task Team is co-led by representatives of Portugal and Belgium, two countries that are not part of the Euro-Argo ERIC at the moment.
Gliders	Yes	https://www.oceangliders.org/wpcontent/uploads/2018/06/OceanGliders-sttor.pdf	
Vessels	Yes	FerryBox (not available online) SOT (https://tinyurl.com/yynlx5ac) GO-SHIP (https://www.go-ship.org/About.html)	FerryBox Task Team ToR were updated and finalised during EuroSea. All Task Team members were part of editing, commenting, and accepting the final version. The update was needed as the ToR were in a preliminary form. The international SOT has established a new implementation strategy which includes ToRs: https://www.ocean-ops.org/sot/strategy.pdf

Network	ToR	Document	Progress in EuroSea
Eulerian	Yes	EMSO (no reference provided) OceanSites (http://www.oceansites.org/documents/index.html)	
Sea Level	Yes	http://eurogoos.eu/tide-gauge-task-team/. GLOSS (https://unesdoc.unesco.org/ark:/48223/pf0000217832)	The Terms of Reference were updated in November 2021, reflecting some of the achievements and activities within the EuroSea project. Available through EuroGOOS: https://eurogoos.eu/download/tide-gauge-tt-tor/?wpdmdl=12115&refresh=643fc288519031681900168
HF-Radar	Yes	not available online	Available through EUROGOOS since 2015 at https://eurogoos.eu/download/high-frequency-radar-tor/?wpdmdl=12557&refresh=644b8833b9b0d1682671667
ASV	No	no	

Terms of Reference (ToR) describe the scope and limitations for each network and are important documents. They define the purpose and structure of the network, the goals and the means towards achieving. With the exception of ASVs all other networks operate on publicly available ToRs, while significant updates during EuroSea were done for Argo, FB and Sea Level reflecting the widening of the group as well as EuroSea project activities.

Governance structure established and documented

Table 14. Observing network governance framework with links to respective documents with progress during EuroSea

Network	Governance	Document	Progress in EuroSea
Argo	Yes	https://www.euro-argo.eu/About-us/The-Research-Infrastructure/Statutes	The former Argo EuroGOOS Task Team was the Euro-Argo ERIC Management Board (MB), with Euro-Argo ERIC status acting as the TT ToR. The TT now has its own governance (2 co-chairs nominated for 3 years with the possibility of one renewing) and ToR.
Gliders	Yes	OceanGliders Steering Team (https://www.oceangliders.org/about-us/organization/) EuroGOOS Glider Task Team (http://eurogoos.eu/gliders-task-team/)	During EuroSea, the chairing of the EuroGOOS Glider TT has changed. Effort was made to identify the wider glider community in Europe – survey in collaboration with GROOM II project.
Vessels	Yes	FerryBox: Chair and co-chair Others – no information provided	For GO-SHIP, a EU project (EuroGO-SHIP) was kicked off
Eulerian	Yes	Members organization for EUROGOOS (ROOS); EMSO (CMO, ExCom, AoM) http://emso.eu/organization/; OceanSites (http://www.oceansites.org/documents/index.html)	New chairs in EuroGOOS TT – first meeting in CNR spring 2023.

Network	Governance	Document	Progress in EuroSea
Sea Level	Yes	EuroGOOS Tide Gauge Task Team, with a Chair and a Vice-chair, committed to support (among other international programs) the implementation of the global sea level network (GLOSS) in the region, although not all the tide gauges operated in Europe do contribute or belong to the GLOSS Core network. GLOSS governance structure includes a GLOSS Technical Secretary at the Intergovernmental Oceanographic Commission (UNESCO), in Paris, and a chair.	New chair and two co-chairs appointed from NOC, in the UK (chair and co-chair) and SHOM, in France (co-chair). Additional members were sought from countries with no representation, resulting in 4 new members from Greece. A further 7 new members have been recruited to the Task Team during the EuroSea project.
HF-Radar	Yes	EuroGOOS Task Team. Nevertheless, the overall governance of the European HF Radar community will be reviewed (D3.4 M18) clarifying the role of each HF Radar operator and the endorsement of the EU HF Radar Node.	The HF radar community governance has been updated, in alignment with the EuroGOOS Task Team TOR, in the D3.4 (https://eurosea.eu/download/eurosea-d3-4-hfr-governance/?wpdmdl=3585&refresh=644bb2b30f32c1682682547) clarifying the role of each HF Radar operator and the endorsement of the EU HF Radar Node.
ASV	No	Work in progress under OceanGlider initiative and EuroGOOS Glider TT Global: DBCP	Working progress under OceanGlider initiative and EuroGOOS Glider TT. (GEOMAR Navigator website + PLOCAN Observing Platforms).

During EuroSea all networks had the opportunity through their workshops to discuss Governance issues and in some cases as with the HF Radars to work on a Governance document (D3.4) which explores different options and possibilities. In many networks new chairs took over while in the case of Research Vessels the GO-Ship project is expected to significantly contribute to the organization of the community.

Self-assessment on representing of the respective European observing efforts via the network

Table 15. Observing network representation of EU observing efforts with progress during EuroSea

Network	Representation of EU efforts	Comment	Progress in EuroSea
Argo	High	Euro-Argo ERIC coordinate all the European contribution to the Argo international network	Thanks to the change of scope of the Argo TT of EuroGOOS, which now provides opportunities for Euro-Argo ERIC to discuss with non-ERIC countries, Euro-Argo ERIC has a better overview of all European Argo efforts.
Gliders	Medium - High	By providing metadata ingestions into the JCOMMOPS (now: OceanOPS) metadata base; RT and DM of several parameters that contribute to EOVs for European coastal and open seas. Representation in International OceanGliders initiatives (Science teams, data teams)	Also, what has been made possible by the EuroSea project is the setup of a community best practices documentation shared not only by the EU glider community, but also the international community. This is a terrific improvement for the EuroGOOS glider TT. In addition, EuroSea allows the whole glider community to meet several times virtually, on different topics (data management, best practices) maintaining the dynamic of the group.
Vessels	Medium	Coordinates European Ships of Opportunity activities, links to European and international research infrastructures and initiatives	For GO-SHIP and repeat hydrography as standalone network EuroSea had limited visibility, but a different EU project with such a focus was successfully kicked off (EuroGO-SHIP)
Eulerian	Medium	Currently 8 sites are registered as EMSO ERIC regional ocean/coastal facilities and 5 of those have registered metadata to the global system (OceanSites).	

Network	Representation of EU efforts	Comment	Progress in EuroSea
		However, in the global system 13 European institutions registered > 50 sites as being currently in operation.	
Sea Level	Medium - High	Delegates/representatives from the most relevant actors, for all European basins: main national network operators and sea level scientists involved, considering all different approaches/applications of tide gauge observations: experts from oceanography, geodesy, hydrographers, storm surge and tsunami warning, meteotsunamis and harbor users.	Several actions in the framework of EuroSea contribute to better reflect European sea level observation efforts: organization of two workshops (January 2021 and May 2023) involving the heterogeneous organizations and experts, including the global community; development of a new data portal providing sea level measurements obtained from the new GNSS-IR technique, based on existing GNSS receivers in all countries, and development of a comprehensive inventory of tide gauge stations, with basic metadata, for the European network. New partners and institutions were contacted in the Mediterranean Sea during a collaborative work published in Ocean Science: https://os.copernicus.org/articles/18/997/2022/
HF-Radar	Medium - High	The observational network attempts to have all the European HF Radar operators involved	Since 2022, we have developed the https://www.hfrnode.eu/ website, which is a central point for access to the European HF radar node, and to HF radar network and systems technical specifications, HF radar tools (HOORT and map of systems), and links to providers information, publications and data. In parallel, we have been promoting a strategy for DOIzation of HF radar networks to increase the visibility and be able to measure the scientific impact of the data from the different systems.
ASV	Low - Medium	EuroGOOS Task Team (gliders), Ocean Glider group at GOOS and OceanOps level. No	EuroGOOS Glider Task Team, OceanGliders

Network	Representation of EU efforts	Comment	Progress in EuroSea
		connection made to provisional global network (DBCP ASV action group)	The achievements in the context of EuroSea will have continuity in a global context through the cooperation framework established with the OASIS program led by NOAA and already endorsed by UN Decade.

This particular question explores how networks see themselves as representatives of the whole EU community. Argo made a significant step towards inclusivity by expanding membership beyond the Euro Argo ERIC, benefiting from the extensive network of members of EuroGOOS and its ROOSs. Although it is a major objective of all networks to be as inclusive as possible, this is pursued through the EuroGOOS framework. However, further actions could be explored through other channels.

Linkages to the global observational networks

Table 16. Observing network links to the respective global observing efforts with progress during EuroSea

Network	Links to Global Observing Efforts	Comment	Progress in EuroSea
Argo	Strong	It's the European contribution to Argo international	One of the co-chair of the EuroGOOS TT was involved in the organisation of the 7th (international) Argo Workshop in October 2022, as an active member of the scientific committee.
Gliders	Strong	OceanGliders is an associated program of the GOOS.	The EuroGOOS glider TT is trying to guide most of the European glider community not involved yet in the OceanGliders program to join through sharing data and metadata and following community best practices. As said above, many virtual meetings occurred during the EuroSea project and others to come will benefit from it. However, more coordination could be made within the EuroGOOS glider TT on particular topics, including the extension to ASV, data management, or other topics that would need coordination and cooperation.
Vessels	Ferrybox: Medium Underway metocean: Strong	Ferrybox: Some links to SOT MetOcean: Embedded in SOT Research cruises: links to GO-SHIP	The FerryBox Task Team organised two workshops with operators, users, stakeholders, and industry partners. The first was on 17-18 March 2021 (virtual due to COVID-19, but hosted by SMHI) which was co-organised with the EuroSea HF-Radar task. The second workshop was held in-person on 28-29 October 2022 in Geesthacht, Germany (Hereon). The FB TT as a so called "SOT associated network" reports to all regular sessions of the SOT (next May 2023). With EuroGO-SHIP now underway, the next meeting of the

Network	Links to Global Observing Efforts	Comment	Progress in EuroSea
	Research cruises: medium		international GO-SHIP committee is suggested to take place as a side event of the EuroGO-SHIP yearly GA. Inside the SOT, the European contribution was always very significant.
Eulerian	Medium	EUROGOOS exchange with EU research infrastructure initiatives EMSO, EURO-Argo, EMBRC, ICOS and international networks (OceanSites, OOI, ONC, IMOS)	
Sea Level	Strong	With a clear vocation from the start of contributing to an improved implementation of the GLOSS network in Europe, as reflected in the Terms of Reference. The EuroGOOS Tide Gauge Task Team activities have been regularly presented at the GLOSS Group of Experts meetings since 2016. GLOSS representatives in Europe have been invited to participate in several actions and meetings. The chair of the task team has recently reported on recent activities at the last GLOSS data centers meeting.	The global community, GLOSS chair and technical secretary were invited to the two workshops organized in the framework of EuroSea (e.g.: January 2021 minutes meeting iMS09, May 2023 minutes to be provided as internal milestone). Many TGTT members also have GLOSS membership and the next TGTT annual meeting will be held alongside a GLOSS data centers meeting in Autumn 2023 to facilitate collaboration and co-ordination.
HF-Radar	Strong	a) Reporting and contributing in the GEO HF Radar Network, b) Technical exchanges for	For the organization of 2 workshops, March 2021 and November 2022 led by the EuroGOOS HF Radar Task Team , the link with the global network has

Network	Links to Global Observing Efforts	Comment	Progress in EuroSea
		establishing a European standard on data management based on existing Best Practices at Global level, c) European contribution in Best Practices on Operations based on existing material available at Global level, d) Organizing the ingestion of Global data through the EU HF Radar Node (Pilot with US data in 2020)	been promoted. The specific development of the HOORT tool has been performed in close contact with active members of the Global community (MARACOOS). Finally, efforts performed in the management of metadata will benefit the Global effort of OceanOps.
ASV	low	No connection made to provisional global network (DBCP ASV action group) Bi- or multilateral collaboration between institutions (MBARI, SAEON, UCSD, LAMMA, CEFAS, GEOMAR, PROOCEANO, Memorial University, GOOS-OceanGliders Group, IOOS, IMOS, Marine Robotics Consortium (EUMR), etc.	International links: MBARI, SAEON, UCSD, LAMMA, CEFAS, GEOMAR, PROOCEANO, Memorial University, GOOS-OceanGliders Group, IOOS, IMOS, Marine Robotics Consortium (EUMR), etc. NOAA, TPOS, UK Maritime and Coastguard Agency, Associated British Ports, Spanish Ports Authority, Spanish Marine Merchant Authority, IMO, French Maritime Affairs Agency, The Maritime Alliance. In addition, a large list of international leading ASV developers are joining the initiative (XOCEAN, Saildrone, Liquid Robotics, AutoNaut, EXAIL, TIDEWISE, SubSeaSail, OceanAero, Offshore Sensing, Open Ocean Robotics, among others. The achievements in the context of EuroSea will have continuity in a global context through the cooperation framework established with OASIS program led by NOAA and already endorsed by Un Ocean Decade.

All networks perform quite well on this, with active linkages to the respective global observational efforts and basically those of GOOS. For example, Euro Argo is the European component of the Argo program and although networks such as Gliders, Tide Gauges and HF Radars are not at the level of an ERIC with a legal structure, they are well connected and in many cases EU members have a leading role.

Network Internal Performance and Targets

Sensor/Instrument/Hardware Best Practices availability

Table 17. Observing network Best Practices for hardware with progress during EuroSea

Network	BP	Comment	Progress in EuroSea
Argo	Yes	Argo has defined a set of EOV and endorsed sensors to measure them and defined a process to accept new sensors (http://www.argo.ucsd.edu/Argo_Framework.html)	This webpage is no longer valid. General information on framework Argo can be found here: https://argo.ucsd.edu/expansion/framework-for-entering-argo/ A specific paper was published in 2019 for Best Practices regarding BGC floats and sensors: https://www.frontiersin.org/articles/10.3389/fmars.2019.00502/full and the same kind of paper for core-Argo should be submitted in 2023.
Gliders	No	Work in progress. Available but fragmented. OceanGliders has a Best practice Task Team	SOPs are available here: https://github.com/OceanGlidersCommunity . Also, a paper on community best practices is being produced and should be submitted before September 2023. This work is led by Pierre Testor and has been more than initiated during the EuroSea project.
Vessels	Yes	JERICO-RI Deliverable, unclear; GO-SHIP manuals	For most operators, best practices for sensor/instrument/hardware are still from JERICO-RI projects and CMEMS In Situ TAC: EuroGOOS FerryBox White Book: https://repository.oceanbestpractices.org/handle/11329/1502

Network	BP	Comment	Progress in EuroSea
			Use of biological and biogeochemical sensors with observing platforms including FerryBoxes: https://repository.oceanbestpractices.org/handle/11329/350 Status of FerryBoxes: https://repository.oceanbestpractices.org/handle/11329/317 GO-SHIP: Hydro manual, https://www.go-ship.org/HydroMan.html, gradually transferred to the OBPS, e.g. https://repository.oceanbestpractices.org/handle/11329/1023 SOT-SOOP: OBPS
Eulerian	Yes	a) Some best practices are available for sensors and EOV (e.g. DOXY), b) FIXO3 legacy BP available on OBPS and published on Marine Frontiers (Pearlman et al., 2019), c) EMSO ERIC BP on DO and Underwater Intervention to be released in Feb 2020 and made available on OBPS.	
Sea Level	Yes	The ones defined for and by the GLOSS (Global Sea Level Observational System) global network, GLOSS manuals, oceanbestpractices.org: IOC Manuals and Guides No.14, Volumes I,II,III,IV,V (IOC, 1985,1994, 2002, 2006, 2016)	WP5 Tide gauges will be accompanied by a a EuroSea maintenance manual which will supplement the GLOSS manuals

Network	BP	Comment	Progress in EuroSea
HF-Radar	Yes	JERICO-NEXT Deliverable “D2.4: Report on Best Practice in the implementation and use of new systems in JERICO-RI. Part 1: HF-radar systems'' “Best practices on High Frequency Radar deployment and operation for ocean current measurement” C.Mantovani et al., 2020 Accepted in Frontiers Best Practices in Ocean Observing.	Best practices are available at the OBPs global repository (https://www.oceanbestpractices.org/repository/)
ASV	Yes	Ocean Best Practice Portal IODE	

All networks have established some Best Practices or SOPs and there were significant improvements during the EuroSea project which significantly helped the networks to work towards this. It is worth noting the example of Gliders. However, improvements in the near future need to be considered in particular for the Eulerian network given the large variability of the platforms which possess significant constraints - hard to define BPs that cover all the range.

Data Quality assurance (QA) and Control (QC) strategies

Table 18. Observing network QA & QC with links and references with progress during EuroSea

Network	QA	Comment	Progress in EuroSea
Argo	Yes	Metadata are quality controlled (Format checker at GDAC) and checked regularly against JCOMOPS data base Both RT and DM Quality assessment procedure are defined (http://www.argodatamgt.org/Documentation)	No change in website
Gliders	Yes	QA on delayed mode QC data	Information on QA/QC is available here: https://github.com/OceanGlidersCommunity. But there is no harmonization across DAC on QA/QC yet, even in the European partners. Coriolis DAC align QA/QC of the glider they manage with Argo QA/QC. Documentation is available here: https://www.seanoe.org/data/00343/45402/. The BODC is currently developing a capacity to QA/QC its glider data set in real time. Ahead of harmonisation, a working group within EuroGOOS Glider TT on QA/QC seems to be a priority. Finally, the community Best practices paper to come will undertake this question at the international level.
Vessels	Yes	via CMEMS-INSTAC	Data management: https://repository.oceanbestpractices.org/handle/11329/658 CMEMS INSTAC Biogeochemical data quality control: https://archimer.ifremer.fr/doc/00645/75704/

Network	QA	Comment	Progress in EuroSea
			Quality control of biochemical data: https://repository.oceanbestpractices.org/handle/11329/430 GO-SHIP: Hydro manual, https://www.go-ship.org/HydroMan.html, gradually transferred to the OBPS, e.g. https://repository.oceanbestpractices.org/handle/11329/1023 SOT:OBPS
Eulerian	Yes	For water column EMSO follows OceanSites QA and QC (GDAC CORIOLIS): PAP, DYFAMED, E1-M3A. International Metadata (JCOMMOPS) lags regular update	EMSO is following the same procedures with GDAC and plan to go further by integrating BGC variables like O2, pCO2, pH (link to ICOS and ARGO cookbooks) Metadata are quality controlled by JCOMMOPS technical Coordinators.
Sea Level	Yes	The ones defined for the GLOSS global network at different GLOSS manuals, and adopted by the different GLOSS data centers. Available in oceanbespractices.com. Other sea level data portals may have, or not, their own QA standards, that ideally should converge to those defined for GLOSS	GLOSS QC recommendations have been progressively updated according to changes in data requirements and data flow of sea level data in recent years, and included in deliverables of different European projects (e.g: MyOcean, Atlantos..) and in the EuroGOOS DATAMEQ document on QC. A new upgraded GLOSS QC manual was published in 2020 by members of the EuroGOOS TGTT, Permanent Service for Mean Sea Level, NOAA and the Hawaii Sea Level Center experts, among others, to compile existing approaches now available, not only in Europe, but also in the global community: IOC (2020). Quality Control of in situ Sea Level Observations: A Review and Progress towards Automated Quality Control, Vol. 1. Paris, UNESCO. IOC Manuals and Guides No.83. (IOC/2020/MG/ 83Vol.1) (2020).

Network	QA	Comment	Progress in EuroSea
HF-Radar	Yes	Included in C.Mantovani et al., 2020. Accepted in Frontiers Best Practices in Ocean Observing	JERICO-NEXT Deliverable "D5.14: Recommendation Report 2 on improved common procedures for HFR QC analysis, including recommended common metadata and data model for HFR current data for HFR data implementation in European marine data infrastructures" + Best Practices included in above references. Best practices are also available at the OBPs global repository (https://www.oceanbestpractices.org/repository/).
ASV	No	work on it during the project - QARTOD	Partially developed, work in progress

Significant improvements have taken place during EuroSea and with the exception of the ASV which is starting network, all other networks show a high degree of maturity.

International Standards Compliance

Table 19. Observing network compliance to international standards with progress during EuroSea

Network	Int. Stand	Comment	Progress in EuroSea
Argo	Yes	All data are available through GDAC in Netcdf format CF compliant, used SeaDataNet Vocabularies for variable names, institution code and is setting up a Vocab to manage all the Argo reference tables (link ENVRI-FAIR project)	Progress was made since 2019 to ensure FAIRness of Argo data and metadata, including the use of the NERSC Vocabulary Server (NVS) to control Argo vocabulary and improve machine-to-machine FAIRness, in collaboration with the ENVRI-FAIR H2020 EU project. The system should be ready to move from Excel spreadsheets to the NVS before the end of the ENVRI-FAIR project, in June 2023 (although the standards remind the same).
Gliders	Yes	OceanGliders standards (close to Argo and OceanSites)	Yes, thanks to EuroSea, a big effort was made possible to coordinate the standardisation effort in the international glider community. It led to some successes, SOPs, Github repo for best practices, BUFR format for gliders. Before EuroSea the glider community had no space to discuss standard and BP, after EuroSea the way forward is clear, the priorities are identified and the infrastructure to work on these items is operational.
Vessels	No	No, not at this time	The SOT finalized and implemented a new metadata format which matches WMO-WIGOS requirements and also includes a new unique identifier system. Tracking/mapping of data flow from repeat hydrography faced big challenges and led to the establishment of a unique and full lifetime cruise identifier which should simplify the process.
Eulerian	Yes	EMSO ERIC: OGS/SWE - OceanSites specifications (report). JCOMMOPS delivers	

Network	Int. Stand	Comment	Progress in EuroSea
		metadata through WMO/WIGOS compliant format	
Sea Level	Yes	Contribution to their definition and improvement in collaboration with GLOSS experts, e.g: Netcdf format CF compliant is already used in Europe (CMEMS) and is being adopted as well by GLOSS data centers.	The new data flow strategy: Deliverable 3.3: New Tide Gauge Data Flow Strategy: https://eurosea.eu/download/eurosea-d3-3-new-tide-gauge-data-flow-strategy/?wpdmdl=3584&refresh=6440032e6073f1681916718 defines a route to achieve consistency of data standards
HF-Radar	Yes	existing international standards have been considered for establishing the European ones. Regular communication with GEO HFR Network is taking place.	The standards for the Data Model used by the European community have been established before EuroSea. However, the evolution of the Global solutions for data management (as metadata requirements and ERRDAP system) has been taken into account in EuroSea activities.
ASV	Yes	ISO and OGC, among other possibilities.	

All networks consider international standards with major improvements during EuroSea. Progress is required for the Eulerian while for the Vessels the FerryBox is a particular network specific to Europe.

Exchange of metadata and data with European data centers

Table 20. Observing network metadata and data with the EU data centers and data aggregators with progress during EuroSea

Network	SeaDataNet	CMEMS	Emodnet	Comment	Progress in EuroSea
Argo	Yes	Yes	Yes	All data are available through GDAC in Netcdf format CF compliant, used SeaDataNet Vocabularies for variable names, institution code and is setting up a Vocab to manage all the Argo reference tables (link ENVRI-FAIR project)	No change occurred, but Euro-Argo signed an MoU with the Copernicus Marine Service and one with EMODnet to specify areas of collaboration, including exchanges of data and metadata.
Gliders		Yes		through glider GDAC Coriolis	About 10 glider groups serve data and metadata to Coriolis DAC, EMODNET and SeaDataNet. For most of those groups, the entry point is the Coriolis GDAC. However, EMODnet and Copernicus Marine Service are consuming metadata from EGO and OceanOPS. Despite this good performance, a huge potential of improvement exists in Europe.
Vessels	No	Yes	Yes		primarily with EMODnet Physics For the FerryBox Task Team, still primarily EMODnet Physics via EuroGOOS ROOS data centres. Some discussion and

Network	SeaDataNet	CMEMS	Emodnet	Comment	Progress in EuroSea
					progress has started in terms of an Ocean OPS dashboard and also visualisation tools via EMODnet Physics or SeaDataNet. For the SOT and GO-SHIP, OceanOPS is the central repository for metadata and provides an API and daily exports which can be (and are) used by all other parties to access the database.
Eulerian	Yes	Yes	Yes	SEANOE and CORIOLIS (OceanSites and EMSO GDAC) exchange with SeaDataNet & EMODnet	OCEANOPS is partnering with SeaDataNet for vocabulary harmonization
Sea Level	No	unclear	unclear	data exchange is ad hoc and, on a country,-by-country basis, with no formal reciprocal agreement. GLOSS data centres do not submit data to SeaDataNet on behalf of other countries.	The EuroGOOS Tide Gauge Task Team is in fact working actively now, one of the actions in EuroSea, in improving access to metadata in the region, and to make it available to GLOSS and Copernicus Marine data portals. The EuroGOOS TT took lead in metadata management by setting up a TG inventory and involving both EMODnet and Copernicus Marine Service In Situ TAC, as well as SONEL (https://www.sonel.org/?lang=en) to

Network	SeaDataNet	CMEMS	Emodnet	Comment	Progress in EuroSea
					contribute to the continuous update of vertical land movement information of the product.
HF-Radar	Yes	Yes	Yes	The standards include all the SeaDataNet requirements and the EU HF Radar Node will feed the SeaDataNet archive system.	The European HFR node acts as the central point for collecting and switching towards standard metadata from operators towards marine data integrators (Copernicus Marine Service, EMODnet and SeaDataNet), both in NRT and REP reprocessed datasets. During 2022 through Eurosea WP3 we have developed the https://www.hfrnode.eu/ website, which is a central point for access to the European HF radar node, and to HF radar network and systems technical specifications, HF radar tools (HOORT and map of systems), and links to providers information, publications and data. In parallel, we have been promoting a strategy for DOIzation of HF radar networks to increase the visibility and be able to measure the scientific impact of the data from the different systems.
ASV	No	No	Yes	ISO and OGC, among other possibilities.	Collecting and switching towards standard metadata from operators

Network	SeaDataNet	CMEMS	Emodnet	Comment	Progress in EuroSea
					towards marine data integrators (Copernicus Marine Service, EMODnet and SeaDataNet)

Mixed picture towards the three main data aggregators although considering operationality all networks exchange metadata with CMEMS. There were improvements during EuroSea towards SeaDataNet and EMODnet.

Visibility of the network

Best Practice Documentation accessibility

Table 21. Observing network Best Practices availability with progress during EuroSea

Network	OBP	Comment	Progress in EuroSea
Argo	Yes	There is an Argo community Section in OBPS repository	2 references were added for the year 2021 and one for 2020.
Gliders	No	In process	The Oxygen SOP has been published on Ocean Best Practices Repository. The community best practice under preparation aims to be published there too.
Vessels	Yes	GO-SHIP manuals (research vessels), RVOSP developing	All relevant best practice documents are in the OBPS repository
Eulerian	Yes	Several in OBPS repository	
Sea Level	Yes	GLOSS Manuals are already included in the in OBPS repository	Technology and quality control manuals are in the OBPS repository. A tide gauge maintenance manual deriving from WP5 will be added soon.
HF-Radar	No	Ongoing, through JERICO-RI outputs & Peer Review Paper just submitted	Mantovani et al., 2020, "Best practices on High Frequency Radar deployment and operation for ocean current measurement" paper was accepted in Frontiers Best Practices in Ocean, https://doi.org/10.3389/fmars.2020.00210. All relevant best practice documents are in the OBPS repository.
ASV	No	Priority	Draft document released

All networks now share their BP through the OBP repository, a practice that is now considered as a common objective and priority for all networks.

Key performance indicators (KPIs) (definition and monitoring)

Table 22. Observing network KPIs with progress during EuroSea

Network	KPIs	Comment	Progress in EuroSea
Argo	Yes	Argo Network is monitored carefully through JCOMMOPS which generates indicators on network implementation and data processing The Euro-Argo ERIC generates additional KPI to monitor the European contribution to Argo and publish them in the Euro-Argo Annual report.	Since 2019, the already defined KPIs have been gathered in a section of Euro-Argo website, which is updated once a year with new figures (in June): https://www.euro-argo.eu/KPIs. Two new KPIs have also been introduced: the number of operational floats for each of the three missions of OneArgo (Core, BGC and Deep) and the number of operational Euro-Argo floats measuring BGC variables (one for each key variable).
Gliders	No	Under definition	We have created KPIs for OceanGliders to measure the implementation of the program, the data flow performance, to assess the diversity of the program, the performance of the glider missions, and the operational capacity. All those indicators can be adapted to the EurGOOS glider TT.
Vessels	Ferrybox: No		Number of operational FB routes (with access to data) in CMEMS and EMODnet.
	MetOcean: No		

Network	KPIs	Comment	Progress in EuroSea
	Research Vessels: Yes	For GO-SHIP and via Seadatacloud	KPIs are calculated regularly by OceanOPS
Eulerian	No	In progress…Some are defined at JOMMOPS and in EMSO but not yet for all networks. Implementation Targets needed first	
Sea Level	No	Not yet	Number of operational TGs (no duplicate, coherent time granularity) in different data portals including EMODnet and Copernicus Marine Service and IOC Sea Level Station Monitoring Facility
HF-Radar	No	Some Indicators are defined through the ingestion of EU HF Radar Node outputs into INSTAC Global Production Unit. More KPIs will be developed on JERICO-S3	Number of operational HFR (with access to data) in CMEMS and EMODnet. Outage reporting through HOORT tool, from the networks connected to the European HFR node (https://hoort.hfrnode.eu/)
ASV	No	Not yet	Number of operational ASV units and endurance lines (with access to data) in CMEMS and EMODnet.

In terms of KPI's, although at the beginning of EuroSea, KPI's were adopted basically by the two ERICs (EuroArgo and EMSO), in the framework of EuroSea, KPI's have been discussed in the framework of the various network specific workshops and are becoming a standard practice. As expected in these first steps the choice of the appropriate KPI's depend on the network, but in the future the adoption of some common KPI's should be a subject of discussion between networks.

Data availability on Global Telecommunication System (GTS)

Table 23. Observing network data availability on GTS with progress during EuroSea

Network	NRT to GTS	Comment	Progress in EuroSea
Argo	Yes	All data are transmitted within less than 12 hours from acquisition.	The previous statement refers to temperature, salinity and oxygen (adjusted field only for oxygen). Specifications have been submitted to WMO to request BUFR sequences for the transmission of 4 additional BGC parameters: Nitrate, pH, Chlorophyll-A and Backscattering. After a test phase, these new variables (in "adjusted" mode) will also be transmitted in NRT to the GTS.
Gliders	Yes		gliders now have a dedicated BUFR format for T, S and deep average current. It is described here: https://github.com/wmo-im/BUFR4/issues/16
Vessels	All: No		For FerryBox, GTS is generally not transmitted. Some meteorological installations by national met offices may be transmitting GTS. SOT-SOOP data flow to the GTS for XBTs and TSGs is in principle unchanged. Transmission in alphanumeric code has mostly ended, table driven code is now general standard with regular update of the format, noting that the latest template for Voluntary Observing Ships comprises not only atmospheric but also a full suite of oceanographic parameters now. From some GO-SHIP cruises, CTD data now flow in NRT to the GTS.
Eulerian	Partly	For some nodes: ANTARES, PAP,	

Network	NRT to GTS	Comment	Progress in EuroSea
Sea Level	Partly	In Europe only SHOM tide gauge network and some stations from the UK network are today transmitting to GTS. The reason: in the past this was facilitated via the meteorological agencies, not always easy in some countries, and also due to the lack of personnel and funds to upgrade to GTS properly. Today this is one goal for the whole tide gauge network, especially after requirements defined by the new Tsunami Warning Systems implemented in the region.	The EuroSea WP5 tide gauges in Barcelona, Taranto and Buenaventura will transmit data via the GTS. Discussions on-going to extend this functionality elsewhere in Europe.
HF-Radar	No	The organization of data management is recent. Discussions are on-going.	
ASV	No	No, because we haven't had any access to WMO, that is going to be changed to web services like WIS 2.0. Then, what we expect is to release data but not through GTS	Connection with WMO already established.

Data policy

Table 24. Observing network data policy with progress during EuroSea

Network	Comment	Progress in EuroSea
Argo	Open and free data policy	No change
Gliders	Open and free data policy	No fundamental change. However, EuroGOOS glider TT data policy will align with the WMO and IOC recent update on data policy. No changes for SOT or GO-SHIP.
Vessels		For the FerryBox Task Team, no common data policy in place in 2019 and still no common data policy other than those put forth by CMEMS/EMODnet Physics. SOT goes with the new WMO data policy: https://ioc.unesco.org/index.php/news/new-wmo-unified-data-policy-implications-ocean-data No changes in GO-SHIP - but establishment of a Data Management Team to work on it.
Eulerian	For most of the sites the data are free and in open access through GDACs (legacy of FIXO3 for data policy)	
Sea Level	Open and free data policy, as for the GLOSS global network: IOC Oceanographic Data Exchange Policy:	Not significant changes apart from new stations now available since 2019 in EMODnet and Copernicus Marine Service in Situ TAC from several countries in the Mediterranean Sea.

Network	Comment	Progress in EuroSea
	https://www.iode.org/index.php?option=com_content&view=article&id=51&Itemid=95). However, there are still some countries in the region that do not share tide gauge data yet (especially North of Africa stations, important in the Mediterranean Sea)	
HF-Radar	Open and free data policy	All HF-Radar data processed and distributed by the European HFR Node are licensed under Creative Commons CC BY 4.0, which allows the users to share and adapt the data, giving appropriate credits.
ASV	No	EMODnet, Copernicus Marine Service and WMO procedures for ASV data policy have been started and are under definition study.

Most networks operate under an open and free data policy having fully adopted operational characteristics. Furthermore, in May 2023, DataMEQ WG proposed a EuroGOOS data policy which requires the EuroGOOS members commitment to share core ocean data openly according to the FAIR principles and clear licenses. As core in situ ocean data it is considered, at least, the physical and biogeochemical Essential Ocean Variables (EOVs) which are necessary for the Copernicus Marine Service and the EuroGOOS regional operational systems (ROOS), including coastal services, as well as the services delivered by EMODnet. This policy is the European implementation of the IOC Oceanographic Data Exchange Policy.

Coverage and Facilities

Observing Requirements

Table 25. Observing network observing requirements with progress during EuroSea

Network	Drivers for Operational Activities	Progress in EuroSea
Argo	a) near-real time data for ocean and atmospheric services, b) high quality data for climate research, c) measure biogeochemical parameters to address oceanic uptake of carbon, acidification and deoxygenation	A new strategy for Deep and BGC-Argo measurements is presently being defined among Euro-Argo partners, taking advantage of the discussions held during the Deep and BGC-Argo virtual workshop organised in September 2021 as part of EuroSea - D3.16
Gliders	Science	There is a clear demand for glider data for science and operational oceanography across many EOVs. However, there is no clear target on which data and how much data are needed for the operational services.
Vessels	Research and development	
Eulerian	EMSO Science service groups: climate change, geohazard, operational oceanography, MSFD etc.	
Sea Level	a) National services for tides, storm surge and tsunami monitoring, b) Harbour authorities (navigation), c) Geodetic services and national datum definitions,	There has been a move towards providing geocentric sea level and vertical land motion from GNSS receivers to facilitate validation of satellite altimetry and improved estimation of long-term trends by scientists.

Network	Drivers for Operational Activities	Progress in EuroSea
	d) Science	
HF-Radar	a) Science, b) Capacity for model assessment and data assimilation, c) Search and Rescue, d) Response to pollution events (Oil spills…)	Monitoring surface currents is still an important requirement in the coastal area. Then, specific effort has been done during EuroSea workshops to establish the state of the art and new requirements for wave data derived from HF radars.
ASV	a) Science projects b) Monitoring /weather service data	Regulatory operational procedures at national/international level are being developed.

Given the research framework that is around many of the observational efforts one can see that science is a major driver for the observational activities for all networks although operational service requirements are becoming more important for all networks. EuroSea workshops have positively contributed to the requirement setting including prioritization.

Primary drivers for the observational activities

Table 26. Observing network drivers for observing with progress during EuroSea

Network	Drivers for observational plans	Progress in EuroSea
Argo	a) Component of GOOS OCG (or integrated long-term Ocean observation, b) GODAE/OceanPredict: a. operational service b. enhance knowledge on ocean circulation c. climate research d. enhanced knowledge on ocean health and carbon cycle for ecosystem modelling	Euro-Argo financing comes from both short-term projects and long-term funding, with different figures depending on the country. Part of the long-term funding comes from national operational services and the other part from science. However, Euro-Argo is currently under-funded with regards to the observational needs defined at international level in terms of Deep and BGC measurements (OneArgo design - Euro-Argo aiming at supporting one fourth of the international effort) and is looking for additional funding mechanisms to fulfil its commitment.
Gliders	a) science projects, b) long term observation, c) monitoring	In many cases, the funding for the infrastructure can be considered as sustained. But the science produced with the gliders is mostly funded under soft money. Long term observations are supported by sustained sources of funding but only a limited number of long-term observations occur in Europe. PLOCAN, SOCIB, France, Portugal, Italy, Greece and Norway maintain regular lines. Some glider groups (MARS, Ireland, Germany) support environmental monitoring with gliders and the funding of those activities is also based on soft money.
Vessels	a) Science projects, b) monitoring,	For the FerryBox Task Team, most financing is from institutional funds, project funding, and in some cases monitoring programs (that are not

Network	Drivers for observational plans	Progress in EuroSea
	c) in situ validation for remote sensing	necessarily long-term funding sources). For many vessel activities, which often focus on operational met-ocean applications, a significant part of funding is not sustained/long term, but comes out of research projects.
Eulerian	a) Science b) services (operational models & collectivities)	EMSO ERIC is funded by the nations and by EU projects (INFRA calls). The long-term observing systems are funded by the national institutes and Ministries through national IR for some countries.
Sea Level	a) Monitoring b) services	Mostly long-term funding by Member States. According to the answer to the 2016 survey: from a total number of 674 tide gauges, nearly 25% of the stations in the region would be facing problems of national funding in some way. Fortunately, most of these problems have been solved since then.
HF-Radar	a) Operational services, b) Science and model assessment and improvement	There is a mix of long-term funding from different stakeholders (national and regional administrations) and shorter-term support from R&D projects or institutions.
ASV	a) Technology, b) science c) monitoring services	Many of them are from the private sector as “full service”.

Science and Operational services are strong drivers for all networks with a wide mixture of funding sources that inevitably creates a complex environment under which long-term planning is rather difficult. It is indicative that even the “sustained” ERICs, rely heavily on short term funds from projects, for a significant part of their activity.

Dialogue with "thematic networks"

Table 27. Observing network connection with thematic networks with progress during EuroSea

Network	Dialogue Exchange	Comment	Progress in EuroSea
Argo	Yes	a) Link with GOOS as one of the networks of JCOMM, b) Link with IOCCP for the development of BGC-Argo, c) Link with GCOS.	MoUs and a letter of support were signed with key Argo data users in Europe: EMODnet, Copernicus Marine Service and ECMWF/C3, which should facilitate future discussion with these European entities during annual meetings.
Gliders	No	Through individual partners only. Need for better coordination	
Vessels	Yes	ICOS Ocean Thematic Centre	FB: Continued dialogue and exchange with ICOS Ocean Thematic Centre; new dialogue related to marine CO2 removal measurement, reporting, and verification (MRV). Also, some links to wind farms and environmental conditions and harmful algal blooms related to aquaculture. For SOT activities, pilot projects with the shipping industry are underway with the aim to evaluate the value of met-ocean data collected with ship-owned instruments for their own purposes, and if a dialogue with ship owners could help to establish science standards regarding instruments, maintenance and data protocols, so that such data could be shared and of required quality. Some of the pilots are driven by individual network partners, some by SOT Task Teams.
Eulerian	Yes	a) EMSO is involved in acidification issues by providing pH, pCO2 data through	

Network	Dialogue Exchange	Comment	Progress in EuroSea
		fixed observatories (surface and deep waters) – ICOS, b) EMSO has started some dialogue with Augmented Observatories (e.g. genomic sampling in NW MedSea) - EMBRC	
Sea Level	No	Not formally yet, but individual experts are integrated in the task team. Not a particular reason for that, this is something we could improve in the future (e.g. the hydrographic offices in our case)	Most of the work done by individual network partners at this stage, shared and agreed with other partners in the EuroGOOS Tide Gauge Task Team meetings.
HF-Radar	No	Only isolated connection, no connection at network level implemented yet, because the first steps has been focused on internal organization (relatively new network: 2014)	
ASV	No	We don't yet have an observational network. We are working to setup the network. In the meantime, however, there is already specific activity/applications with ASV technologies trying to cover needs for all these science aspects and more (i.e. ICOS for CO2 measurements, EMSO for cross-calibration, MARCET for Marine Mammal monitoring, FRONTEX – Border surveillance, etc.)	Offshore Energy Sector (i.e. monitoring wind farms), Air-Sea Interactions, Hurricane-Storms, Border Surveillance, Marine Mammal, etc.

This is an area where improvements are necessary, considering that in most cases some connection with ICOS and although some network partners might have developed such connections individually with other thematic networks such as the Augmented, this needs to be pursued centrally as a network coordinated activity.

Future aspirations

Practices in developing future operations

Table 28. Observing network future plans & priorities with progress during EuroSea

Network	Future Plans Process	Progress in EuroSea
Argo	a) Extend to create a fully global, top-to-bottom, dynamically complete, and multidisciplinary Argo program, b) Extend the Euro-Argo contribution to maintain ¼ of the new Argo Design	Euro-Argo is presently working on defining its vision and mission as part of its strategy for the next decade, taking into account the new OneArgo design defined at Argo international level.
Gliders	Organically around the OceanGliders Themes (Task Teams) and through the EuroGOOS Glider Task Team	The GROOM II project, where many of the EuroGOOS glider TT members are working on a mission and vision for the GROOM RI. This is an important improvement for the development strategy of the glider activity in Europe.
Vessels	Current plans are to expand to provide better regional coverage of European seas (Mediterranean and Arctic) and further develop use/validation of biogeochemical and biological sensors.	FB: Some degree of involvement with the GOOS SOOP-IP has begun during EuroSea. GO-SHIP: a stronger European community has been established and led to the EuroGO-SHIP project. Third party data from private sector/industry partners will play a growing role: a framework for coordination could be the UN Ocean Decade labelled Odyssey project: https://oceandecade.org/actions/ocean-decade-odyssey/
Eulerian	a) Implement more biological sensors (imagery, genomics), b) Develop integration with others infrastructures (EURO-ARGO, ICOS, EMBRC)	

Network	Future Plans Process	Progress in EuroSea
Sea Level	Aligned with GLOSS plans, and based on new needs derived from the increasing demand of tide gauge data today, required for diverse services and challenges as mean sea level rise and monitoring of extreme events. To fulfil this, the network is continuously being upgraded	Densification, use of low-cost sensors and new technologies is considered and explored for some applications.
HF-Radar	a) Integrating National plans, b) Establishing Requirements driven plans at Regional levels, c) Contributing in integrated approaches for developing the coastal network	The work on proposing a suitable governance (D3.4) includes the description of the long-term Strategy in the context of the wider EuroGOOS Strategy 2021-2030. A quantitative framework has also been established for describing the status of the network and could be used for establishing targets and monitoring the development.
ASV	Setup a task team in order to identify activities to be covered according the needs by different end-users and stake	To contribute to the global strategy for Autonomous Maritime Navigation framework strategy led by IMO, where ASV as specific MAS are included.

EuroSea has helped most networks to update future plans with more mature networks operating under a defined strategy in line with their vision and mission.

Where do you see your network in 2030?

Table 29. Observing network vision

Network	**The network in 2030**
Argo	2500 T&S floats 1200 Deep float (4000/6000), 1000 BGC, good coverage of European marginals seas including high latitude (partially ice-covered areas) and moving closer to the coast
Gliders	Sustained and significant EU contribution to the 100 glider endurance lines foreseen by OceanGliders in 2030 (see OceanObs'19 CWP)
Vessels	Need to be defined
Eulerian	Depends on EuroGOOS and EU visions, members involvement; European players not involved in EuroGOOS drafted a vision as "*A truly global network for Eulerian Time series stations that is fully embedded in the Global Ocean Observation System and provide interoperable data considering latest scientific understanding*"
Sea Level	The tide gauge network is already well consolidated and a key element of the ocean observing system for coastal sea level observations, and this will be so for sure in the future.
HF-Radar	As a key component of the coastal ocean observing systems (like Met radars in Met networks)
ASV	A consolidated network at EU level, fully operational providing services according to needs, and with strong international links (IOOS-US, Canada, IMOS-Australia, South Africa, South America, etc.). Network acting as POC for current uses and potential future ones of this technology as strong component of Digital Ocean strategy (OceanGliders for GOOS)

Answers are a mix from a "device centered vision" (the network target is to have x devices in the water by 2030) to a vision with the priority towards coordination at EU level and connection with global efforts.

Major challenges and opportunities for the operation of future operations

Table 30. Observing network challenges and opportunities with evolution during EuroSea

Network	Challenges and Opportunities	Progress in EuroSea
Argo	a) The new design cost is 3 times the original one; b) Challenges in term of technology/sensors for deep measurements; c) Challenges in term of QC for BGC measurements and coastal observations.	a) The funding challenge is still a major issue; b) The technology and sensors for Deep measurements has greatly progressed in recent years and is not a major challenge anymore, although there is still room for improvement and work is continuing, in particular for the diversification of sensor providers; c) BGC data management, although progress was made and scenarios are presently being discussed between Euro-Argo partners to decide on a way to organise BGC data management and more particularly DMQC at European level.
Gliders	a) Major challenges: integration in the EU MRI landscape; system consolidation and sustainability (persons, infrastructures, vehicles); b) Major opportunities: integration with the other observational networks; biological EOVs; regional/coastal operational oceanography; services for public policies, market and innovation.	a) In terms of Challenges: a) Progress has been made during the period of EuroSea with regard to the integration in the EU MRI landscape. However, the strategy on how to accomplish this challenge is still unclear for the EuroGOOS glider TT. Creating an ERIC through the ESFRI program or joining an existing ERIC is still debated; b) The consolidation of the European glider network has progressed. With more than 200 vehicles identified and 20 glider groups in many European countries the EuroGOOS glider TT is healthier than ever. Infrastructure has progressed in most of the cases and the reliability of the glider fleet also progressed along the EuroSea years;

Network	Challenges and Opportunities	Progress in EuroSea
		c) However, the sustainability of the human resources at the national level is still difficult and the support to European activities like EuroGOOS glider TT is still not funded yet. b) With regard to the opportunities, progress has been made with regard to the integration of biological EOVs thanks to the Bioglider project (EU project) and many other national initiatives. Some progress has been made in terms of operational oceanography thanks to EuroSea by bringing together the regional data assimilation community and the glider community. It may, (still pending at the time of writing), lead to an international task team on this topic under OceanGliders. Progress on capacity building and engagement of new countries and teams interested in glider ownership and operation has been done within the framework of EuroSea in order to increase the community and derived added value.
Vessels	a) All partners are busy with funding issues and project commitments at home institutes; b) It is important for the network to inspire more cooperation and involvement from partners to be able to push progress and innovation.	a) In addition to funding issues COVID-19 was a period during which many passenger ships and some cargo ships altered or stopped operations. This affected operations of FerryBoxes on ships that were affected. Increased willingness from private sector and industry partners to (co-) fund met-ocean activities as part of their sustainability program could be one of the big opportunities. b) Projects like EuroSea significantly help in keeping the community together while providing resources towards objectives and priorities.
Eulerian	a) Challenges: sensors and technology for deep water observation, cost maintenance for cabled observatories, integration of biological sensors (e.g. eDNA),	

Network	Challenges and Opportunities	Progress in EuroSea
	harmonization of best practices and establishment of label; b) Opportunities: better integration with ERIC and global networks, metadata distribution; c) International: Creating and evolving a coordination framework that keeps to be attractive for the contributors without centralized funding.	
Sea Level	a) Increasing requirements on data sampling and precision, and access to real time data, requires adapting the management of data and the tools for quality control and quality assessment (this has already started); b) The network has evolved over the years and we foresee as well new improvements and technologies for coastal sea level measurements and data flow, including iOT and machine learning techniques. Adaptation of existing stations to these improvements may be a difficult challenge in most countries; c) As mean sea level rise continues to be a problem, the use of this data in platforms integrating models and altimetry data for helping in the decision-making process will be essential and will require adaptation of tide gauge operations.	a) Consistency of data processing and standards is still a problem but the Task Team is addressing this through the data flow strategy and workshop on quality control. and us establishing a Tide Gauge Metadata Inventory/Data Portal working group; b) A new challenge is the potential unco-ordinated development of the GNSS-IR technique for sea level monitoring which could result in different technology standards and processing techniques, so the TGTT has established a global special interest group to agree on a common approach. and to explore a Copernicus GNSS-IR sea level product c) Classical harmonic methods of tidal prediction are heavily relied upon but advances in AI mean that other techniques are being tested. The TGTT is leading an IAPSO-funded initiative to evaluate the various methods currently in use.
HF-Radar	a) Integration with water column monitoring from fixed platforms; b) Integration with Satellite products; c) Ingestion into modelling capacities; d) Integration with BGC &Biological monitoring.	As mentioned in the initial analysis, after the needed structuration of the network, the main challenges will remain in the integration of the operations with other coastal platforms. In this context, the strategy for consolidating a coordinated European infrastructure should be implemented in coordination

Network	Challenges and Opportunities	Progress in EuroSea
		with other networks, first in the coastal area (JERICO-RI) and more generally (EOOS), as described in D3.4.
ASV	Identify and provide true support services to end-users in regards common long-term goals at both scientific and technology level (CHALLENGE) + Gliderport and endurance-line network implemented at EU level (OPPORTUNITY).	Fill the gaps between fixed platforms and underwater mobile vehicles, from the specific capability of ASV that is monitoring air/sea variables in both performing transects and fix positions.

At the beginning of the EuroSea project for the networks, more challenges existed than opportunities. This is expected as in order to be able to see opportunities, appropriate mechanisms inbuilt in the network structure are necessary. Foresight exercises, efficient connections with other global networks and with the decision centers are all required. Several of these challenges have been addressed during EuroSea helping networks to move towards opportunities but it should be mentioned that it is important that challenges are identified and prioritized.

EuroSea Activities

Task objectives

Table 31. Observing network objectives during EuroSea and progress made towards these

Network	Objectives within EuroSea	Progress in EuroSea
Argo	To coordinate the development of the Argo extensions, deep - below 2000m (DEEP) and biogeochemical (BGC), in liaison with the Euro-Argo-Rise (Technology) and the ENVRI-FAIR (data interoperability) projects, and in close link with the Argo international network. Interoperability with other observations that acquire similar observations within the EOOS framework will also receive attention (with applications in WP7): a) consolidate, with Euro-Argo Eric Management Board, DEEP and BGC operations strategy (Atlantic, MedSea) considering input from CMEMS, EMODnet and the EuroSea demonstrator projects most critical weaknesses (applications and budget); b) develop Best Practices for DEEP & BGC Argo operations and data management via workshops and WP7 feedback, and upload to OceanBestPractices.org; c) support interested countries to engage with Argo in the Atlantic and Mediterranean Sea in partnership with Euro-Argo;	During EuroSea the following were achieved: a) This objective is being tackled at the moment and will be achieved by the end of the EuroSea project; b) Best Practices were discussed during the Deep and BGC Argo workshop organised in 2021 and exchanges occurred with the Gliders community regarding BGC data management and Quality Control; c) This objective was addressed as part of the change of scope in the Argo EuroGOOS TT, whose focus is now to help new institutes and countries involved in Argo to enhance their engagement with Euro-Argo ERIC. In collaboration with the EA-RISE project, regional (online) workshops were also organised in 2021 that enabled to get new contacts with Turkish and Danish scientists. Denmark became a “Candidate” country of the Euro-Argo ERIC in 2022; d) Less progress than expected was achieved for this objective, due to delays in the recruitment of the BGC project officer. The person started in November 2022 and will participate in the diffusion of Euro-Argo ERIC progress in EuroSea in the course of 2023. The communication of BGC-Argo will be fostered during 2023.

Network	Objectives within EuroSea	Progress in EuroSea
	d) enhancement of the Euro-Argo Eric and international BGC, website/newsletters to highlight Euro-Argo ERIC progress in EuroSea.	
Gliders	The major objectives at the start of the project: a) Contribution to OceanGliders and EuroGOOS Glider Task Team activities; b) Best practices publications in peer-review journal and on IODE repository; c) Elaboration of EU long term glider plans for EOOS; d) Support for EuroSea demo activities.	Achievements and progress towards objectives: a) All activities within EuroSea feeds the EuroGOOS glider TT strategy and aligns with the OceanGliders objectives; b) BPs for Oxygen have already been published in the Ocean Best Practice repository, while others (salinity, nitrate, depth average currents and Chl-a) are under progress as mentioned in Table 21; c) Vision and Mission for a European glider infrastructure has been defined with the contribution of GROOM II project. Several options for the EU glider infrastructure have been/are examined including the establishment of an ERIC, a non-profit association or a loose network (mainly within EuroGOOS); d) Don't know.
Vessels	To improve SOOP & RV coordination in Europe by: a) Encouraging countries so far not involved to the EuroGOOS FB Task Team to join; b) Linking regional/global efforts (ICOS ERIC, SOCAT, JCOMMOCG-SOT); c) Re-evaluate/finalize Best Practices (in dialogue with SOT) and formulate Terms of Reference for the network; d) Provide cost assessments for operations, data management according to FAIR, and evaluation for game-changing technologies (autonomous sampling	For the FB TT all objectives have been fulfilled, but work still remains as the landscape has changed since the beginning of EuroSea (COVID-19, technology developments via new Horizon 2020 and Europe projects, etc.). a) During the two workshops institutes operating FB external to the network were invited to participate; b) Activities towards this objective were included in the workshop and is an ongoing action; c) For vessels in general, the development and implementation of fit-for-purpose metadata formats, unique identifiers for stations and cruises, and coordination of activities across all observing networks that require ship assistance (including deployment / maintenance/ recovery of autonomous devices) has reached maturity;

Network	Objectives within EuroSea	Progress in EuroSea
	systems, nutrient analyzer/sensors, towed device technology).	d) Although these were addressed during the WS's further progress is required and is one of the future priorities of the respective EuroGOOS TT.
Eulerian	a) Upgrade pH sensor on EMSO-DYFAMED node (WP6 and WP7); b) Harmonize Best Practices OceanSites & EMSO; c) Progress on metadata catalogue for Eulerian observatories with JCOMMOPS.	a) Although due to COVID-19 there were delays, the objective was achieved and reported in D3.6; b) Best practices update was more recommendations report provided by OceanSites and EMSO staff but larger endorsement is necessary to provide Best Practices handbook; c) It proved difficult today to provide a complete metadata information to integrated fixed platforms in the EU into the OceanOPS portal. This will/should progress with an update of metadata catalogue including details of sensor type deployment, maintenance cruises, etc…
Sea Level	a) Establishment of an integrated European Tide Gauge Network as part of EOOS; b) Improve connection of the European and global community (GLOSS), by means of the following actions/activities: a. Improve metadata inventory of stations based on current user requirements (e.g. JCOMMOPS, CMEMS, Tsunami Warning Systems) b. Analyze gaps/duplicity in data portals providing tide gauge data and design a new strategy for data flow for tide gauge data storage, quality control and distribution c. Assess/compile an on-line portal in PSMSL (Permanent Service for Mean Sea Level) of uplift/subsidence land data, including new	a) The network has/is participating into EOOS Operations Committee and is closely linked with the EOOS activities and plans. Moreover, it is fully in line with the EOOS strategy; b) Major progress has been achieved during EuroSea and specifically: a. A metadata inventory tool has been developed and distributed through EuroGOOS Tide Gauge Task Team website, now being completed by the different partners and institutions: http://eutgn.marine.ie/geonetwork/srv/spa/catalog.search#/home b. An on-line tool has been developed by SONEL to facilitate gaps/duplicates analysis: https://www.sonel.org/tgcat. A new data flow strategy has been described in Deliverable 3.3: New Tide Gauge Data Flow Strategy: https://eurosea.eu/download/eurosea-d3-3-new-tide-gauge-data-flow-strategy/?wpdmdl=3584&refresh=6440032e6073f1681916718, with contributions from the EuroGOOS TGTT but also from GLOSS data portals, EMODnet and Copernicus Marine Service In Situ TAC;

Network	Objectives within EuroSea	Progress in EuroSea
	Multipath Reflectometry of land-based Global Navigation Satellite Systems (GNSS-MR) technology. d. Organization of two workshops involving the global community	c. A new GNSS-IR data portal is now available through GLOSS Permanent Service for Mean Sea Level data portal: https://psmsl.org/data/gnssir/ d. The first workshop was organized in January 2021 with more than 160 attendants (virtual meeting). The second workshop was held as a hybrid event in Madrid, 4-5 May 2023.
HF-Radar	a) Enhance use of HFR surface current data and added value products; b) Push the availability of FAIR HFR data and implement Best Practices of HFR operations and maintenance; c) Define a governance structure that ensures long-term sustainability; d) Guide the development of the network with a prioritization performed at Sea-basin scale.	a) The objective has been achieved through the work of standardisation and management of data performed through the HF Radar node; b) The objective has been persued through the Node and specific tools (e.g. HOORT); c) A new HF Radar Governance has been written examining different options (reported in D3.4); d) This objective has been achieved through the development of the HF radar node web page, the HF radar interactive map and the implementation of DOIs for HF radar systems.
ASV	a) ASV-Network definition and roadmap addressed to cover current and future user's needs, including access to infrastructures, community roadmap monitoring, promoting knowledge exchange, enhancement and partnership worldwide with the establishment of an ASV User Group; b) improvements on Standard Operating Procedures (SOP) for derived BP implementation on operational protocols, data management, knowledge transfer, risk assessment, legislation, etc. in order to properly improve the ASV technology, contributing to the EOOS implementation plan;	a) Yes, D 3.5 ASV network + cooperation framework established with OASIS Program led by NOAA (endorsed by UN OceanDecade); b) Yes, D3.5 ASV Network; c) Both workshops were achieved despite the problems due to COVID-19. The first one took place online in October 2021, while the second was a hybrid in April 2023.

Network	Objectives within EuroSea	Progress in EuroSea
	c) Perform 2x workshops aiming at ASV technology - challenges, opportunities and user engagement, and ASV technology - Best-practices implementation. All to support the EuroSea demonstrator activities, in particular WP7 that will provide important feedback on ASV usage.	

Most objectives defined in the project proposal have been achieved although due to the problems caused by COVID-19 most workshops originally designed, had to be adjusted to the new conditions. Thus, the pre-COVID-19 in person meetings were changed into online ones and although interactions in the latter are constrained, participation has immensely increased. This helped aspects like being more inclusive, connecting with other networks etc but it possibly made harder things that require active exchange such as Best Practices.

Observational networks cross cutting activities

Table 32. Observing network cross cutting activities during EuroSea and progress made

Network	Cross cutting actions	Progress in EuroSea
Argo	a) Cross cutting with GOSHIP, and EMSO for Deep measurement, b) Cross-cutting with GOSHIP, ICOS, EMSO, Gliders, Ferrybox and JERICO for BGC measurement, c) Cross-cutting with EuroFleets for operation at sea	Although 3 discrete cross cutting activities were originally identified, during the course of the project it was considered that it is better to aim towards a more inclusive approach which will include all a), b) and c). Thus, a Marine RIs workshop was co-organised by 11 RIs in 2021, as a side event to the 9th EuroGOOS Conference, led by Euro-Argo, in the framework of the EA-RISE H2020 project. This workshop allowed the RIs to discuss and identify several areas of cooperation between them. A dedicated session was also organised during the Deep & BGC Argo workshop in 2021 to exchange with other networks where these discussions were continued, within an international context. Some leads were proposed to enhance collaboration between various networks, such as participation of other networks in annual network meetings, or through OCG (see details in the workshop reports, here). Following these discussions, Euro-Argo, EMSO, GROOM, EuroGOSHIP, ICOS, EuroFLEETS and JERICO communities recently gathered, together with OceanOPS and other important stakeholders in the domain, to prepare the AMRIT proposal in answer to the Horizon Europe INFRA-2023-DEV-01-04 call. The AMRIT project which will be funded will enhance effective cross coordination and improve integration between these ocean observing networks in the EOOS context.
Gliders	Best practices on EOV basis and design of EOOS	Best practices were produced/are in progress in the framework of a wide collaboration (Ocean Gliders, GROOM II), while participation and contribution

Network	Cross cutting actions	Progress in EuroSea
		into EOOS activities such as the operation committee, ensures the contribution to the EOOS design.
Vessels	Sensor data QC/QA and data handling.	During the two WS (March 2021 & September 2022) specific sessions were dedicated on sensor data QC/QA and data handling, with the participation of other networks and data experts. Moreover, in the framework of cross cutting activities, the FerryBox Task Team will continue with cross-cutting activities with ICOS-ERIC, EMSO-ERIC, JERICO-RI (JERICO-S3 and predecessors), and the sensor development H2020 project NAUTILOS and digital twin of the ocean project AquaINFRA. The FerryBox network has been involved in EOOS planning and will continue interactions where necessary/relevant. Finally, considering the OceanOPS platform, as a key EOOS enabler, all activities with vessels across all observing networks are tracked by OceanOPS and organically lead to increased cooperation along ships as a vital resource for almost all ocean observing activities - key to success will be the submission of corresponding metadata. The allocation of station and cruise identifiers is now an operational standard.
Eulerian	EMSO ERIC, OceanSITES, ICOS, EURO-ARGO (BGC variables)	BGC variables were discussed in the framework of the WS organised by the network as well as in other opportunities such as WS organised by other networks and related events.
Sea Level	Most of the actions are focused on specific needs of the tide gauges network, except perhaps the approach followed for	There was collaboration with GNSS data providers e.g SONEL, Unavco regarding the use of GNSS data for sea level by exploiting the GNSS-IR technique.

Network	Cross cutting actions	Progress in EuroSea
	the new metadata inventory. Possible collaboration during workshops.	
HF-Radar	Contribution to the multi-platform approach of Task 3.9 Integrating science mostly developed at regional level and strong contribution in the building of JERICO-RI.	As planned HF Radars contributed to Task 3.9 as a show case of integrating science. Moreover, they are a core network within JERICO and as such are contributing in the JERICO-RI design and development. Finally, there a common workshop with the Ferrybox Community was organised in March 2021 ("High frequency radars and Ferrybox joint workshop") during which cross cutting activities were among the subjects.
ASV	Sharing facilities and infrastructures, payload, cross-calibration, multiplatform experiments, technical support, data formats, some operation procedures, training, legislation, end-user and applications	This was illustrated through the ATL2MED Saildrone ASV mission https://www.saildrone.com/missions/atl2med

Cross cutting activities are in the portfolio of all observing networks while taking advantage of EuroSea as well as from other EU projects and initiatives several of them were pursued. Once more there is a marked difference between the networks with the more mature ones exhibiting a richer and multi-dimensional activity.

Biggest achievements within EuroSea

Table 33. Observing network major achievements during EuroSea

Network	Progress in EuroSea
Argo	● Improvement of the European contribution to OneArgo with procurement and deployment of 5 Deep floats and 5 BGC floats, 9 still active and that collected so far 269 deep Argo profiles and 450 BGC (5 variables) Argo profiles; ● Revised Deep and BGC Argo strategy in Europe (in progress - D3.16); ● Collaboration with gliders network (data management / SOP, see here); ● Deep & BGC Argo workshop in September 2021, including discussions between networks and propositions for collaboration (see section 3 of the reports here); ● Denmark joined Euro-Argo as a "candidate" in 2022 (13 countries) and Poland changed its status from Observer to Member in 2023; ● A change of scope of the Argo Task Team of EuroGOOS was initiated in 2021. New Terms of Reference for the Task Team have been endorsed by EuroGOOS governance late 2022. This change of scope includes better articulation between the Task Team and the Euro-Argo Management Board, and emphasis on the role of the Task Team in facilitating the collaboration between Euro-Argo and its potential new members. The new Task Team is co-led by representatives of Portugal and Belgium, two countries that are not part of the Euro-Argo ERIC at the moment; ● Progress was made since 2019 to ensure FAIRness of Argo data and metadata, including the use of the NERSC Vocabulary Server (NVS) to control Argo vocabulary and improve.
Gliders	● Development of OceanGliders Best Practices and framework to progress on BP and standards (one overview paper in prep. and Standard Operating Procedures for Salinity, Oxygen, Nitrates, Depth-Average Currents, Chlorophyll). Links with OBPS. Best practices production; ● OceanGliders GitHub community (BP and in particular on data management). OceanGliders 1.0 format; ● Data management meeting that has a strong impact on the European glider infrastructure road map; ● Increased number of gliders (200 in Europe) operated by numerous groups (more than 20) falling under the EuroGOOS Glider TT. Increase the community members through a continuous capacity building and engagement strategy; ● Progress made on glider data assimilation.

Network	Progress in EuroSea
Vessels	• FerryBox workshops that brought together 100+ participants from various research, industry, education, and policy sectors. Participants included underrepresented nations in FerryBox-based ocean research including: including Bulgaria, Cyprus, Tunisia, Chile, and Brazil; • The FerryBox Task Team added four new members and finalised the Terms of Reference; • Six new FerryBoxes in European seas; • FerryBox platforms were included and implemented in several Horizon 2020, Horizon Europe, and EEA projects; • In the last 3 years, the European FerryBox Task Team has joined the OceanOPS/GOOS Ship Observations Team as an "SOT associated network" and solidified links via SOOPIP meetings and presentation at the SOT-12 meeting in May 2023; • Definition and implementation of SOT metadata format; • Adoption and implementation of unique station identifier scheme; • Adoption and implementation of unique cruise identifier scheme (available from early cruise planning stage); • Developed links between EuroSea and Eurofleets+ during a workshop dedicated to Research Vessels (iMS44) to better define identifiers for research cruises, machine-to-machine cruise plan exchange, metadata flow from underway systems installed in research vessels; • Establishment of a GO-SHIP Data Management Team and approval of the EuroGO-SHIP project.
Eulerian	• Interactions with EMSO, OceanSites and OceanOPS were initiated. This allowed us to highlight the gaps in the metadata to better value and display the activities of the sites in OceanOPS. Some actions have already been taken in the data service group of EMSO ERIC; • Update of recommendations for sensors and QC procedures for fixed observatories.
Sea Level	• New tide gauge metadata inventory tool: http://eutgn.marine.ie/geonetwork/srv/spa/catalog.search#/home; • On-line tool for gaps/duplicates analysis of the tide gauge data portals: https://www.sonel.org/tgcat; • New data flow strategy: Deliverable 3.3: New Tide Gauge Data Flow Strategy: https://eurosea.eu/download/eurosea-d3-3-new-tide-gauge-data-flow-strategy/?wpdmdl=3584&refresh=6440032e6073f1681916718; • New GNSS-IR sea level data portal available through GLOSS Permanent Service for Mean Sea Level data portal: https://psmsl.org/data/gnssir/; • Collaborative work published in Ocean Science: Coastal sea level monitoring in the Mediterranean and Black Seas: https://doi.org/10.5194/os-18-997-2022.

Network	Progress in EuroSea
HF-Radar	● 1. Main improvement for structuring the community (hfrnode tools, newsletters, doi strategy); ● Updated Governance for the EU community (D3.4); ● Contributions to OBPs; ● Website for the HF radar node and ongoing action for increasing systems and providers visibility by assigning DOIs to systems; ● Development of HF radar community tools for data discovery (interactive map) and system management and outage reporting (HOORT).
ASV	● Two workshops have been held (October 21 and April 23) in order to bring together the main actors in this ASV technology (academia, industry (manufacturers and services) and governments) mainly from Europe and United States, but also from other countries (Canada, Brazil), to identify the strengths and weaknesses of the ASV technology to contribute to global ocean observing strategies (EOOS, GOOS, etc.); ● The main members of the ASV community (public institutions and private companies) have been identified and engaged with these initiatives both in Europe and in the USA. The definition of the main working topics on which the ASV network initiative should be built, such as the regulatory framework (national and international), Services and Data & Metadata, Standard Operating Procedures and Future trends in the market; ● Engage many of them as User Group members; ● ASV Network definition and roadmap; ● Disseminate the initiative at international level; ● Establishment of a cooperation framework with the OASIS Program led by NOAA and already endorsed by the UN Ocean Decade.

3.2. Thematic networks topics

Internal Organization

Website

Table 34. Network visibility with progress during EuroSea

Network	Website	Progress in EuroSea
Augmented Obs.	http://glomicon.org/	https://www.nerea-observatory.org/ https://www.embrc.eu/emo-bon https://eurogoos.eu/biological-observations-working-group/
Interface with In Situ data integrators	http://eurogoos.eu/data-management-exchange-quality-working-group-data-meq/	no enhancement per se but a better understanding of the links with the Eurogoos networks from CMEMS and EMODnet

Institutions involved

Table 35. Participation of national institutions into the networks.

Network	Partners	Progress in EuroSea
Augmented Obs.	50 organizations are networked, as well as other networks and consortia	~50 organisations are networked, as well as other networks and consortia. Many are not part of EuroGOOS (eg, SZN) since they are institutions working on marine biology and ecology (and not focussed in oceanography). This limitation should be overcome in the future by an active "recruitment" phase by EuroGOOS.
Interface with In Situ data integrators	EU integrators (CMEMS, SeaDataNet, EMODnet mainly Physics and Chemistry Emodnet), H2020 projects, EuroGOOS TT's	One of the EuroGOOS tide gauge TT leaders has been involved as a partner in the In Situ TAC of the Copernicus marine service (contract started December 21) which has eased the EU collaboration and the links with the international community.

Terms of Reference (ToRs)

Table 36. Network ToRs with links and progress during EuroSea

Network	ToR	Document	Progress in EuroSea
Augmented Obs.	No	Under discussion: GLOMICON – The Global Omics Observatory Network (https://sites.google.com/view/glomicon /home) is a grassroots initiative, but will be formalizing under GEO BON as an Omic BON – the Thematic Biological Observing Network (https://geobon.org/bons/thematic-bon/omic-bon/) , which will require a ToR	new EuroGOOS WG on biological observations (with related ToRs)
Interface with In Situ data integrators	Yes	http://eurogoos.eu/data-management-exchange-quality-working-group-data-meq/	The ToR has been updated in March 2022, details are in: http://eurogoos.eu/data-management-exchange-quality-working-group-data-meq/

Governance Structure

Table 37. Network governance framework and progress during EuroSea

Network	Governance	Document	Progress in EuroSea
Augmented Obs.	Yes	Coordination provided by AWI, UC Berkeley – governance is bottom-up	A real Governance at EU level is still missing.
Interface with In Situ data integrators	Yes	EuroGOOS Task Team	Change of Chair in July 2022

Embedding the operations into European observing initiatives

Table 38. Network operations in the framework of EU observing initiatives and progress during EuroSea

Network	Representation of EU efforts	Comment	Progress in EuroSea
Augmented Obs.	Yes	Multiple established marine observatories (e.g. FRAM - FRontiers in Arctic marine Monitoring) have an omics component, EuroSea will upgrade this through the SZN	Many more are now in the process of adding regular -omics sampling. Significant activities during EuroSea have been done in the SZN towards integrated observing efforts (physical, chemical, biological, OMICS).
Interface with In Situ data integrators	Yes	EU integrators (CMEMS, SeaDataNet, EMODnet), H2020 projects, EuroGOOS TT's.	There is continuous improvement to strengthen the links various different channels such as EU projects, WS, as well as in the framework of EuroGOOS activities. AMRIT project will provide support for the immediate future.

Embedding in global observing thematic initiatives

Table 39. Network operations in the framework of global initiatives and progress during EuroSea

Network	Links to Global Observing Efforts	Comment	Progress in EuroSea
Augmented Obs.	Medium	Feeding in expertise and advice to the GOOS BioEco Panel EOVs, we will also attempt to federate under GEO BON (initial discussions already completed)	There was significant feedback toward the UNDOS OBON framework steering committee (https://www.obon-ocean.org/), where EuroSea partners contributed to its creation, the ToRs and to the actual executive activities.
Interface with In Situ	Strong	Argo, OceanSITES, GOSUD - Global Ocean Surface Underway	During the project there were several exchanges by mail and

Network	Links to Global Observing Efforts	Comment	Progress in EuroSea
data integrators		Data (https://www.gosud.org/), OceanGLIDERS, Drifter/DBCP	remote meetings with representatives from these organisations to check propositions made and get information on the deliverables due and linked to cross cutting data management.

In terms of internal organization, Augmented observatories are benefiting from several activities/projects beyond EuroSea and in particular by the establishment of a relevant Working Group on biological observations (BOWG) in EuroGOOS. Although the community is still at its first steps there is a particularly large number of organizations that can potentially join and contribute to the network, while on the positive aspects one has to credit the already good connections with the international community. Despite that there is a light governance through the EuroGOOS BOWG, considering the variability of actors and their interests, this particular topic is among the high priority ones.

Regarding the interface with in Situ data integrators although not a thematic network per se but more like a cross cutting activity it must be mentioned that during the project there were active exchanges with the networks helping them to organize data channels to all main EU data integrators.

Network internal performance, Targets

Number of science cases covered by the thematic network and respective documentation

Table 40. Network science cases covered and progress during EuroSea

Network	Science Cases	Progress in EuroSea
Augmented Obs.	Each node pursues multiple scientific cases in its normal operation, there is (currently) no network-wide scientific mission, but this is being formulated pending improved coordination and interoperation of the nodes.	The establishment of the EuroGOOS Biological Observations Working Group will help towards this as it will provide the platform for coordination of existing nodes as well as with the observing networks.
Interface with In Situ data integrators	There is no network-wide documentation available.	During the project there was contribution to the Copernicus Marine Ocean State Report.

Data Requirements document (incl. link to the relevant Best Practices/SOP)

Table 41. Network Data Requirements and progress during EuroSea

Network	Data Requirements	Progress in EuroSea
Augmented Obs.	a) At the node level – projects in data exchangeability are underway for microbial biodiversity at the taxonomic level which will become a best practices recommendation; b) Recommendations on metadata handling and standards compliance being drafted with the GSC; c) Core data (i.e. sequence data) management at high readiness thanks to the field's use of INSDC norms; d) Prototype exchanges and interfaces with OBIS and GBIF/ELIXIR/ENA.	Importantly, the EMBRC- EMOBON network released a set of SOPs (including protocols for sampling sediments and floating plankton).
Interface with In Situ data integrators	a) Capitalizing on European initiative + existing standards; b) Started first with physical parameters and extending to Biogeochemistry; c) Provided as recommendations to the EuroGOOS communities and presented in EuroGOOS General Assembly; d) For EuroSea integration starting point the AtlantOS WP7 deliverables also delivered to OBPS.	a) Eurosea deliverables allowed some status and comparisons between networks and, recommendations (on metadata and information) have also been proposed with AtlantOS as background as well as relevant papers; b) In situ data integrators harvest GDAC and other databases with a minimum FAIR level on a regular basis, then if a network complies to these points, the resulting data will be available in EU data integrators displaying producer or network credits

Considering international standards (when possible)

Table 42. International Standards considered by the Network and progress during EuroSea

Network	Intl. Standards	Comment	Progress in EuroSea
Augmented Obs.	Yes	Through coordination with the Genomic Standards Consortium	There was progress during EuroSea through both the two

Network	Intl. Standards	Comment	Progress in EuroSea
		and INSDC. We aim to significantly contribute to these and promote interoperability with other standards in the marine observatory space.	WS organised by the network as well as during other occasions such as WSs and meeting organised in the framework of other initiatives.
Interface with In Situ data integrators	Yes	a) Link with Research Data Alliance (link ODIP series of projects) including SeaDataNet Vocabularies and CF conventions; b) DMPA (Data Management Panel area) and (Observation Panel Area) JCOMM coordination activities.	a) closer links to CMEMS INSTAC, EMODnet physics and chemistry b) links with OBPS (D3.17 on metadata recommendations for networks)

Although there is no network-wide scientific mission for the Augmented observatories, each node pursues multiple scientific cases in their normal operation, considering international standards while formulating and documenting SOP's are in progress.

In terms of data, Eurosea deliverables allowed some status and comparisons between networks and, recommendations on metadata and information.

Visibility of the thematic network

Link to EuroSea observational networks (Task 3.1-3.7)

Table 43. Network links with the Observing Networks and progress during EuroSea

Network	Links with EuroSea Obs. Networks	Comment	Progress in EuroSea
Augmented Obs.	Few	Via observatories that have eDNA/omics capacities and also contribute to core oceanography.	a) Created: https://www.nerea-observatory.org/, linked by UNDOS OBON. b) The establishment of the EuroGOOS Working Group on biological observations during EuroSea project will significantly enhance the collaboration with the observing networks as it will act as a platform for

Network	Links with EuroSea Obs. Networks	Comment	Progress in EuroSea
			communication, exchange etc.
Interface with In Situ data integrators	Efficient	a) Well linked to the EuroSea observational networks that have set up or are setting up integrated services in Europe (Argo, Gliders, HF Radars, ICOS for Carbon) or are willing to enhance data interoperability in Europe (Sea Level, Ferrybox) or integrated at international level (OceanSites for Eulerian Observatories, Argo, Drifters/CBCP, Vessels underway data GOSUD); b) For vessels it's also done through SeaDataNet for research cruises; c) Autonomous Surface Vehicles in link with SAILDRONES company.	a) The project allowed for more interaction with the 7 observation networks by going back to them with several propositions and requested feedback. During time, contact and exchange were easier and more relevant on both sides.

Link to international observational networks (Argo, GO-SHIP, GLOSS, …)

Table 44. Network links with International Observing Networks and progress during EuroSea

Network	Links with Intl. Obs. Networks	Comment	Progress in EuroSea
Augmented Obs.	Efficient	a) Well linked to the GOOS, but more work is needed to transition data products from "conceptual" and/or unconsolidated to operational; b) Some omics observers have existing links to GO SHIP and GEOTRACES which we hope to interface with.	a) During EuroSea there was connections with the new BioGeoSCAPES international program. b) The establishment of the EuroGOOS Working Group on biological observations during EuroSea project will help in linking with International Observing Networks

Network	Links with Intl. Obs. Networks	Comment	Progress in EuroSea
			considering that EuroGOOS is a GOOS GRA.
Interface with In Situ data integrators	Efficient	Argo, OceanSITES, GOSUD, OceanGLIDERS, Drifter/DBCP.	In addition, a comparison of data management at international and EU level has allowed us to highlight similarities and differences as well as update some old information of the global networks.

Link to international or even global thematic networks (if exists)

Table 45. Network links with International Thematic Networks and progress during EuroSea

Network	Links with Intl. & Global Thematic Networks	Comment	Progress in EuroSea
Augmented Obs.	Poor	The objective is to form an Omic BON under GEO BON for improved coordination of large- to small-scale projects	
Interface with In Situ data integrators	Efficient	a) Contributing to Data Management cooperation and Operating GDACS for Argo, GOSUD, OceanSITES, b) Contributing to Data Management cooperation and setting GDACS for OceanGliders, Drifters	a) through the EU observation networks involved in the project, yes.

As already mentioned Augmented observatories are well linked to global efforts and initiatives with a good visibility considering the initial stage of the network.

Data management practices at the EU was compared with the international practices, highlighting similarities and differences and through this work all relevant information on the global networks has been updated.

Coverage and Facilities

Coverage of thematic network applications

Table 46. Network coverage of thematic applications and progress during EuroSea

Network	Application coverage	Progress in EuroSea
Augmented Obs.	a) The coverage in the EU is patchy at best, both temporally and spatially. The primary issue is a lack of standardized methodology and best practices and funding structures that are often difficult to link with long-term, observatory-grade monitoring; b) Even a set of local but interoperating observatories would have high impact on the status quo.	a) Thanks also to EuroSea there are now some ongoing initiatives (e.g., the new EuroGOOS working group on biological observations) that comprise several EU research institutions; b) Several observatories (ex. SZN) are establishing integrated observing capacities.
Interface with In Situ data integrators	a) DATAMEQ doesn't operate observing systems and thus it relies on external activities; b) Issues on data policy and unlocking access to existing data; c) critical areas: Arctic, Eastern Mediterranean and South Med, Black Sea; d) Easier for physical than BGC Essential Ocean Variables.	a) EuroSea provided the platform for direct interactions with EU observing networks involved in the project; b) Recommendations have been proposed and EuroGOOS DATAMEQ has written a data policy similar to the IOC one which has been validated by the EuroGOOS members; c) No specific improvement on this point as this one not a specific studied thematic; d) Still true as the observation networks studied are mainly physical ones. However there have been some improvement for the BGC variables, in terms on common metadata for physical and BGC variables.

Dialogue with "observational networks"

Table 47. Network dialogue with observing networks and progress during EuroSea

Network	Dialogue / Exchange	Comment	Progress in EuroSea
Augmented Obs.	Yes	Several nodes in the network are embedded within observational networks, offering a biological dimension. However, these are poorly coordinated, preventing a truly global impact.	The establishment of the EuroGOOS Working Group on biological observations during EuroSea project will provide the necessary platform.
Interface with In Situ data integrators	Yes	Representatives from the observing networks are involved in the DATAMEQ working group.	Significant progress made both within the DATAMEQ working group as well as through direct contact with the experts of the networks involved in the project.

The EuroGOOS data working group DataMEQ is in constant dialogue with the observing networks and since May 2023, it proposed a EuroGOOS data policy which requires the EuroGOOS members commitment to share core ocean data openly according to the FAIR principles and clear licenses. As core in situ ocean data it is considered, at least, the physical and biogeochemical Essential Ocean Variables (EOVs) which are necessary for the Copernicus Marine Service and the EuroGOOS regional operational systems (ROOS), including coastal services, as well as the services delivered by EMODnet. This policy is the European implementation of the IOC Oceanographic Data Exchange Policy.

A clear priority for the Augmented thematic network is the efficient connection with the observing networks which seems to be almost completely missing. It is very important to avoid duplication of efforts and that Augmented observations complement existing operational observations. Considering the possibilities for cooperation offered by EuroGOOS, such aim will be relatively easy to accomplish.

Future aspirations

Practices in developing future operations

Table 48. Network future plans & priorities and progress during EuroSea

Network	Future Plans Process	Progress in EuroSea
Augmented Obs.	Through the GLOMICON coordination (now merged with the Genomic Observatories Network)	The existence of the EuroGOOS WG and of EMBON is allowing to increase the extension of the (still informal) network within a clear context. Still, a

Network	Future Plans Process	Progress in EuroSea
	via mailing lists and focus groups (multipliers, leadership) – coalition of willing participants.	mechanism is missing to permit the formal adhesion to the EMOBON while not being part of EMBRC. This point is currently under discussion with the EMBRC governance.
Interface with In Situ data integrators	EuroSea should rely on existing data management infrastructures and enhance them for a sustain set of services after the end of EuroSea.	Progress made through the interaction with the observing networks, leading to a better understanding.

Major challenges and opportunities for future operations

Table 49. Network challenges and opportunities and progress during EuroSea

Network	Challenges and Opportunities	Progress in EuroSea
Augmented Obs.	Transitioning from a network of primarily academic institutes motivated by "impact" and journal articles, to a fully-fledged observatory community – the reward structures must be realigned. The opportunity now is to leverage the high global interest in eDNA/omic observing (diverting the risk of siloed activity) and the GOOS BioEco Panel's link to the Decade	Also, the creation of EMBRC- EMOBON (and the definition of the related SOPs) now allows setting up new observatories within a clear context and with standardised protocols and pipelines. This is for instance the case for Italy, where three new observatories are now adding -omics protocols as a result of the SZN pilot activity and the use of EMOBON SOPs.
Interface with In Situ data integrators	Challenges are more political than technical. Thus, major issues/ actions are: a) Need big push from stakeholders to support open data policy; b) Dedicated funds for data management should be foreseen for every observing network; c) New services based on big data and Cloud systems should be user driven and not IT driven.	a) Although there have been improvements, the open data issue is an on-going effort; b) Same to the open data policy, sustainable funding is a major issue for all networks including data handling and processing; c) There is still a lot of work to have something easy to be understood and easily accessible to scientific users.

For the Augmented Observatories it is important that a clear mechanism is defined for setting future plans taking into account the various “centers”. Moreover, it is important that eDNA/omic observing activities are operationalised following the example and practices of the physical and chemical observations.

Biggest achievements within EuroSea

Table 50. Thematic network major achievements during EuroSea

Network	Progress in EuroSea
Augmented Obs.	● Support to the creation of a coordination on biological observations: two workshops, participation to UNOS, support to EMBRC EMOBON, new EuroGOOS WG on biological observations; ● Set up of an Augmented Observatory, pilot phase completed, now serving as an example.
Interface with In Situ data integrators	● Better interaction between EU data integrators and with EU observation networks e.g. EMODnet physics with gliders, RF radar, tide gauge; ● Enhancement of collaborations between the 3 EU data integrators: ○ Working together; ○ Who does what; ● First mapping of networks in terms of data management (in line with best practices).

Summary table

Table 51. Thematic Network summary table at the end of EuroSea.

THEMATIC NETWORKS	Augmented Obs.	Interface with In Situ data integrators
Website	yes	medium
No. of Institutions involved	50	10
Terms of reference	no	Yes
Governance Structure	yes	Yes
Representation of EU efforts	yes	Yes

THEMATIC NETWORKS	Augmented Obs.	Interface with In Situ data integrators
Links to Global Observing efforts	medium	strong
Science Cases	multiple	multiple
Data Requirements	Yes	Yes
International standards	yes	yes
Links with EuroSea Obs. Networks	few	efficient
Links with Intl. Obs. Networks	efficient	efficient
Links with Intl. & Global Thematic Networks	poor	efficient
Application coverage	medium	efficient
dialogue/exchange with "observational networks"	yes	yes
Future Plans Process	medium	yes
Challenges and Opportunities	yes	yes

4. Main considerations

Approaching the end of the project, WP3 organized its final hybrid meeting during 1-2 June 2023 in RBINS (Brussels - Belgium). Task leaders and partners were invited to present progress and discuss cross-cutting issues with the future prospects of each network being at the center of attention. More specifically each task was asked to respond to six questions with the only exception Task 3.10 Interface with In Situ data integrators for which the questions were modified. The responses summarize a big part of the network activities during EuroSea and besides illustrating achievements (Table 33 for observing networks and Table 50 for the thematic ones), they offer a critical view on important aspects (in bold) for all networks:

4.1. The EuroGOOS framework

Table 52. Network Positive and Negatives issues in operating through the EuroGOOS framework.

Network	Positive	Negative
Argo	● The change of scope of the Euro-Argo Task Team occurred during EuroSea should: ○ Allow a better articulation between Members (countries) and non-Members of the Euro-Argo ERIC; ○ Help new countries to enter the Euro-Argo ERIC.	● Comes in addition to the Euro-Argo ERIC official bodies and induces duplication of communication channels.
Gliders	● Visibility of the glider network at the European level; ● Links with other Task Teams, Working Groups and ROOSs.	● PI-focused mailing list. We would probably need to evolve to a more inclusive mode (more ECR, students, engineers,...); ● Activities based on good will with no identified resources.
Vessels	● Provides a community and network to foster collaboration and competence building; ● Some degree of harmonisation and best practices developed (with EuroSea WP1 and other EU projects).	● Lack of funding for all partners – many would like to participate/contribute more, but are limited.
Eulerian	● Provide opportunities to start dialogue between different dispersed communities; ● Re-activation of the TT Fixed Observatories as a legacy of EUROSEA T3.4 group.	● Difficult to be attractive and have common goals for dispersed communities; ● Long process and sustained efforts; ● The OceanOPS portal is little used or known: added value must be demonstrated (e.g. EURO-ARGO).
Sea Level	● Increased coordination across Europe; ● Recovery of the European sea level community; ● Sharing success stories; ● Identification of problems and definition of priorities in the region, for all sea level data applications.	● Resources/funding, work based on good will from the task team chairs/members.

Network	Positive	Negative
HF-Radar	• The structure of the Task Team is flexible enough to host the proposed governance in coordination with other components of the EuroGOOS organization; • EuroGOOS is a network with wide participation from key European actors given the 46 EuroGOOS members and more than 100 contributors of the ROOSs. It's easier to integrate even non EuroGOOS members than with a structure like an ERIC that depends on member states ministries.	• Very loose structure based on volunteering of the members; • Infrequent fund support through projects or temporary contribution of members.
ASV	• Support and coordination of the MAS fleet in a single Task Team under the umbrella of EUROGOOS, gathering AUV (OceanGliders) and ASV/USV networks. Coordination with other European observational networks; • Generate and promote SOPs, Best Practices, Data management, and Scientific Development – Knowledge transfer & Training.	• The ASV/USV network is very diverse since it is made up of public institutions and private companies with very different objectives and resources (Science, Social and Military Industry, etc.); • Some EuroGOOS terms and conditions to be considered, in particular for those institutions not being EuroGOOS members. The membership limitation that EuroGOOS represents for the industry sector.
Augmented Obs.	• Good framework for connecting with the oceanographic community; • High visibility; • Context for white papers.	• Support is needed to move forward with the WG; • Connection with biological oceanography still weak (eg, SZN not in EUroGOOS).
Interface with In Situ data integrators	• DATAMEQ ensures the link between EU networks and the 3 EU data integrators; • EuroSea activities will continue in the framework of EuroGOOS ○ Networks to data integrators: work together on data management & enhance collaboration between data integrators	

Network	Positive	Negative
	○ Data integrators to networks: display and give visibility/ access to data networks.	

Considering that all networks operate inside the EuroGOOS framework with some of them already running for few years, it is important to attempt a self-evaluation, identifying positive and negative issues. On the former (positive issues), all networks acknowledge the opportunities for coordination and integration within the network as well as on collaboration with other networks and working groups. Moreover, EuroGOOS provides the necessary connection with the global landscape even though some networks are directly connected with the respective GOOS OCG groups. On the negative aspects, the absence of funding is highlighted as the most important problem (EuroSea is the first project that provided funds directly to the networks), with all activities relying on in-kind contributions by the members despite the secretariat support from the EuroGOOS office.

In order to examine the impact of EuroGOOS TTs and WGs, the networks were asked to describe how they would see **the landscape if EuroGOOS did not exist**. The things that would be mostly missed are: the absence of a coordination framework both internal and external to the network; the cooperation at regional level through the ROOSs; the international connection; the common arena for standardising, promoting, and sustaining observations, data management, and use of data in research and monitoring; the forum for discussion of technological developments, interactions with SMEs for R&D, cross-platform/infrastructure observations; planning together projects and science papers; working together towards sustainability; exchange of knowledge (hubs) and information etc.
Overall, it is a common belief that without the EuroGOOS structure, observing efforts would be fragmented and less integrated with the European and global ocean observing efforts.

Something that was not widely mentioned though, was the capacity that the framework offers to define a common strategy with a clear vision and mission as the case of an integrated European Ocean Observing System (EOOS). This probably highlights the fact that networks being a bottom-up initiative relying as mentioned on in-kind contributions, tend to stay within their limits of their observing technology. Thus, bigger issues such as the EOOS must be pursued at a higher level (top-down) such as EuroGOOS, while networks are asked to participate (e.g. EOOS operations committee).

The European landscape in terms of ocean observations is extremely complex with many different actors operating at all possible levels (local, national, regional etc). Recently, in some countries there are efforts to establish a national structure which will host all observing efforts but this is at its infancy, while the European Research Infrastructures (ERICs) which have the potential to bring together individual observing efforts under a common framework are currently representing a small fraction of the respective community (relatively small participation). With this in mind it becomes evident that each observing network must adequately represent the nations activities (inclusivity) and all networks were asked if they "think that **nations activities are comprehensively represented by their network**". It is interesting to note that more "mature" networks such as Argo, Tide Gauges and FBs answer positively, having promoted inclusivity during the years. Emerging networks such as ASVs and Augmented Observatories are lacking for the moment. Another interesting point

is that the more homogeneous the observing platform is, the higher the inclusivity of the network, something very evident in the case of the Eulerian platforms which seem to suffer from the very big variability in terms of design and applicability.

Network Governance has been identified as another key issue and thus networks were asked to evaluate the various governance types i.e. EuroGOOS loose network with ToRs, ERIC legal status etc. and how adequate these are. Overall, the Task Team / Working Group framework within EuroGOOS, operating under agreed ToRs and chaired by two network members with the support of EuroGOOS office is positively evaluated by all networks. The absence of funding which makes contributions solely on voluntary basis is identified as a major shortcoming while the loose governance structure is seen by some networks as a positive characteristic allowing the necessary degrees of freedom (minimum constraints).

EuroSea project's support to the European marine observing efforts is unique in the sense that unlike other projects which fund short term project specific observing actions, in EuroSea we choose to support existing networks – the EuroGOOS TT's and WG's – helping them to advance in the Framework Processes by Readiness Levels, providing a common vision. Although, progress during the project is documented in the various tables above, the networks were asked on their **next steps and if they see a loss without the EuroSea support and vision**. As expected, all networks value EuroSea as being instrumental helping them to move towards their objectives and priorities efficiently and faster. The project helped them to set priorities and define their next steps and although the original EuroSea plans had to be adjusted to the new COVID-19 reality, all networks greatly benefited. It is indicative that following the experience from EuroSea, all networks now list as one of the priorities to explore similar funding opportunities.

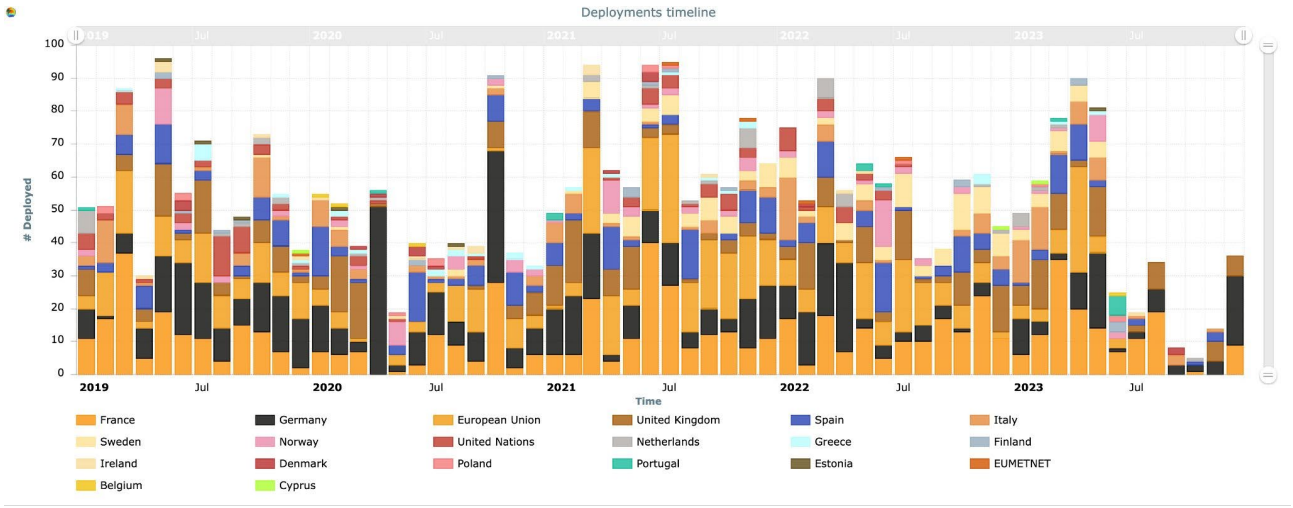
One of WP3 Task 3.10 aims was to work with the observing networks in order **to make more data and metadata visible in European databases**. Through this cross-cutting collaboration there is now a better overview and understanding of what the networks are doing and a basis of working together on key issues (metadata recommendations, EU versus international cooperation, etc.). Moreover, a common data policy based on the IOC one has been agreed between EuroGOOS members. It is worth noting, that despite the different maturity of the observing networks (different capacity in terms of data), common characteristics were identified and shared, helping starting networks to advance quickly and save resources through knowledge and know-how exchange.

Although major stakeholders for the European Observing Networks are **the European Data Aggregators** and one would expect an efficient **collaboration** with well-developed communication channels being in place, this is not always the case (one more maturity is a key factor). Although DATAMEQ has an important role in filling this gap, there are still important unresolved issues, particularly in terms of data flow, data ingestion, network visibility etc which need to be urgently addressed. In particular it is important to understand, describe and design the data flow from each network to the data integrators. This flow must be simple avoiding duplications and with as many as possible similarities between networks – harmonisation through cross data management following Best Practices.

5. Progress in Visibility of European Observations in the GOOS

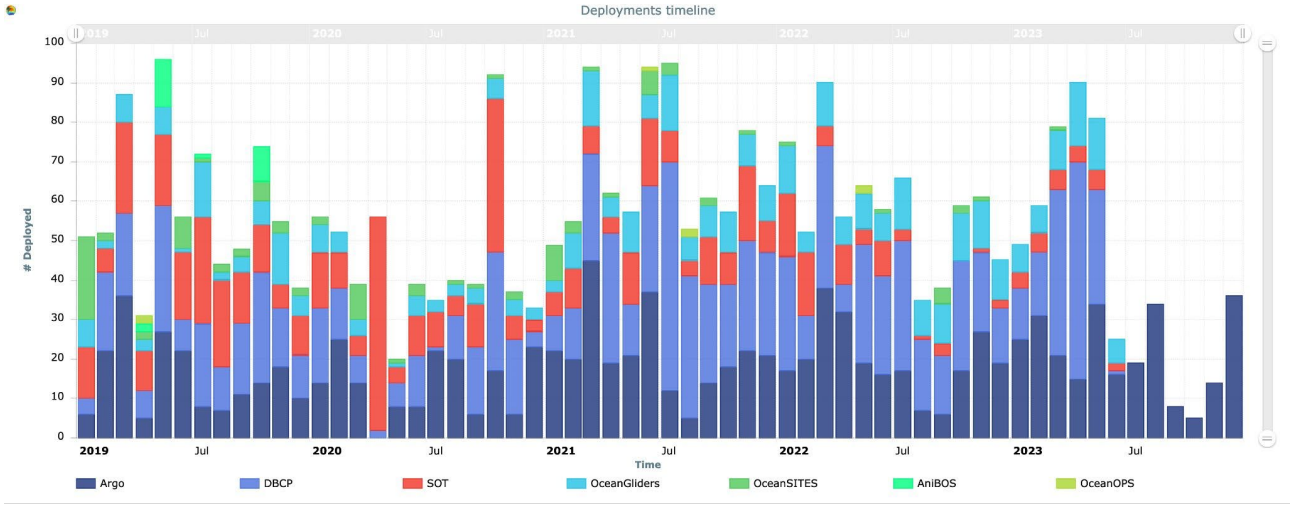
A quantitative assessment for the temporal evolution of the European networks in their visibility in the GOOS was done through the analysis of the OCG official metadata database interface OceanOPS[5]. The assessment was done using the global integrated observational network view on the OceanOPS website and selecting the European countries that are registered (plus European Union) as outlined in the figure below. The time span was from 01. January 2019 to end of 2023, while information after say May 2023 and until the end of 2023 are only category "planned deployment".

First the number of deployments per country for the global ocean were analysed (results are shown in the figure below). No trends are obvious but in fact the deployments vary across time and countries. A drop in early 2020 can be seen that ramps up back to a standard level of 50 to 60 deployments per month across all countries in 2021.



Next the same group of data was analysed from an observational network point of view. Deployments for Argo (profiling floats), DBCP (surface drifter, coastal mooring), SOT (automatic commercial ship observation), OceanGliders (underwater electric glider), OceanSITES (long term reference site), AniBOS (animal borne sensors) and an unspecified observational network labeled "OceanOPS". The networks HF Radar have not been integrated into OceanOPS at this stage and Ferrybox is maybe part of SOT and Sea-level is represented by GLOSS but this network does not report information at this stage to OceanOPS. Also, research ship operations are not covered, maybe because the research ship observational coordination group "GO-SHIP" did not see itself responsible for the observations done - obviously, ships were used for deployment of devices but not registered as contributions to the GO-SHIP network. The figure below also reveals that categorizing by network also does not show obvious trends. At the most dramatic drop in the COVID period (May 2022) virtually only SOT deployments (and a few DBCP) could be done because access to ships was greatly inhibited. It may be worth saying that OceanOPS does not list/requests a EuroGOOS metadata field (e.g. allocated as a metadata field "coordination network").

[5] http://www.ocean-ops.org/



In conclusion it can be said that no obvious impact of the EuroSea efforts are visible. It must be said that EuroSea did not finance a substantial amount of observational technology but still improvements in observational network coordination could have generated more registration of deployments of European countries in OceanOPS.

6. Conclusion

As expected there is a wide variability between the different networks which to a large extent depends on their respective maturity level. Thus, “older” networks are generally more organized with a wide range of activities covering many different aspects in contrast to the “newer” networks in which activities are focusing on a small number of priorities. Another important factor is the connection with the corresponding global efforts as it provides an opportunity to share knowledge and gain from acquired experiences. Finally, those networks that include groups that organize under a legal framework such as an ERIC or an AISBL, contribute to a higher degree of organization exemplifying governance, funding progress on data handling and sharing, providing access to the infrastructure, incentify convergence of various documentations on knowledge into Best Practices, etc. as all the components are prerequisites for maintaining an observing infrastructure.

The main objective of WP3 has been to provide the resources to the existing networks to advance towards Readiness Level 7 in the scale of the FOO (Lindstroem et al. 2012) by Readiness Levels as shown below.

Table 53. GOOS Framework Processes by Readiness Levels and EuroSea target (bold) for individual observing networks.

FRAMEWORK PROCESSES BY READINESS LEVELS (FPRL)			
Readiness Levels	**Requirement Processes**	**Coordination of Observational Elements**	**Data Management & Information Products**
Mature			
Level 9 "Sustained"	Essential Ocean Variable: · Adequate sampling specifications · Quality specifications	System in Place: · Globally · Sustained indefinitely · Periodic review	Information Products Routinely Available: · Product generation standardized · User groups routinely consulted
Level 8 "Mission qualified"	Requirements "Mission Qualified:" · Longevity/stability · Fully scalable	System "Mission Qualified:" · Regional implementation · Fully scalable · Available specifications and documentation	Data Availability: · Globally available · Evaluation of utility
Level 7 **"Fitness for purpose"**	**Validation of Requirements:** · **Consensus on observation impact** · **Satisfaction of multiple user needs** · **Ongoing international community support**	**Fitness-for-Purpose of Observation:** · **Full-range of operational environments** · **Meet quality specifications** · **Peer review certified**	**Validation of Data Policy** · **Management** · **Distribution**
Pilot			
Level 6 "Operational"	Requirement Refined: · Operational environment · Platform and sensor constraints	Implementation Plans Developed: · Maintenance schedule · Servicing logistics	Demonstrate: · System-wide availability · System-wide use · Interoperability
Level 5 "Verification"	Sampling Strategy Verified: · Spatial · Temporal	Establish: · International commitments and governance · Define standardized components	Verify and Validate Management Practices: · Draft data policy · Archival plan
Level 4 "Trial"	Measurement Strategy Verified at Sea	Pilot project in an operational environment	Agree to Management Practices: · Quality control · Quality assurance · Calibration · Provenance
Concept			
Level 3 "Proof of concept"	Proof of Concept via Feasibility Study: · Measurement strategy · Technology	Proof of Concept Validated: · Technical review · Concept of operations · Scalability (ocean basin)	Verification of Data Model with Actual Observational Unit

FRAMEWORK PROCESSES BY READINESS LEVELS (FPRL)			
Readiness Levels	**Requirement Processes**	**Coordination of Observational Elements**	**Data Management & Information Products**
Level 2 “Documentation”	Measurement Strategy Described · Sensors · Sensitivity · Dependencies	Proof of Concept: · Technical capability · Feasibility testing · Documentation · Preliminary design	Socialization of Data Model · Interoperability strategy · Expert review
Level 1 “Idea”	Environment Information Need and Characteristics Identified: · Physical · Chemical · Biological	System Formulation: · Sensors · Platforms · Candidate technologies · Innovative approaches	Specify Data Model: · Entities, Standards · Delivery latency · Processing flow

From the analysis of the detailed questionnaires, network “scoring” in terms of *Requirement Processes*, *Coordination of Observational Elements* and *Data Management and Information Products* categories is shown in the table below:

Table 54. Observing Network evaluation

FRAMEWORK PROCESSES BY READINESS LEVELS (FPRL)								
Level / Network	Argo	Gliders	Vessels	Eulerian	Sea Level	HF-Radar	ASV	Augmented
Mature								
Level 9 “Sustained”	R,C,D	R						
Level 8 "Mission qualified"	R,C,D	R,C,D	R,C		R,C,D	C		
Level 7 "Fitness for purpose"	R,C,D	R,C,D	R,C,D	R,C,D	R,C,D	R,C,D		
Pilot								
Level 6 "Operational"	R,C,D	R,C,D	R,C,D	R,C,D	R,C,D	R,C,D		
Level 5 "Verification"	R,C,D	R,C,D	R,C,D	R,C,D	R,C,D	R,C,D		
Level 4 "Trial"	R,C,D	R,C,D	R,C,D	R,C,D	R,C,D	R,C,D	R,C	R,C,D

FRAMEWORK PROCESSES BY READINESS LEVELS (FPRL)								
Level / Network	Argo	Gliders	Vessels	Eulerian	Sea Level	HF-Radar	ASV	Augmented
Concept								
Level 3 "Proof of concept"	R,C,D	R,C,D	R,C,D	R,C,D	R,C,D	R,C,D	R,C,D	R,C,D
Level 2 "Documentation"	R,C,D	R,C,D	R,C,D	R,C,D	R,C,D	R,C,D	R,C,D	R,C,D
Level 1 "Idea"	R,C,D	R,C,D	R,C,D	R,C,D	R,C,D	R,C,D	R,C,D	R,C,D

R: Requirement Processes
C: Coordination of Observational Elements
D: Data Management and Information Products

It must be noted however that trying to group a particular observing platform into a single network is not always totally possible due to the wide variability. In other words, although for some networks like Argo, Gliders, Sea-Level and HF-Radars there is a uniformity in terms of operations in contrast to the Eulerian platform for example which encompasses many different variations and sub-networks. Thus, inside the Eulerian category there are fixed platforms that belong to OceanSITES and EMSO for example, both of which have a high FPRL (~9), buoys which are part of infrastructures such as JERICO with a lower FPRL (~6) as well as those that are operating on a stand-alone basis or as parts of national observing components with an FPRL below or equal to Level 6 "Operational".

Considering that most networks function within the EuroGOOS framework, this report can act as a possible reporting model of EuroGOOS TT for the future. It was observed that framing an expectation about the structure of what is considered a "coordination network" was helpful. Borrowing the definition from the OCG/GOOS was a good start and created a natural link to the global system this way. It also was observed that "top-down" guidance for groups, such as the EuroGOOS TT and which organize following a "bottom up" approach, is beneficial for both sides: the overlaying organization (EuroGOOS) and the TT. The modalities for the exchange and defining what is most useful for EuroGOOS to get from its TT and what EuroGOOS can give to the TT may need a more complete documentation. Along this line it was proposed during the EuroGOOS General Assembly meeting in May 2023 to consider the EuroSea WP3 final assessment and endorse an annual evaluation/assessment process for each network/task team. By going through this exercise annually, each EuroGOOS Task Team (observing network) will be able to describe its current state, assess progress and most importantly to define next targets and priorities.

From this assessment it can be concluded as a recommendation for EuroGOOS as well as for the EuroGOOS self-organized Task Teams. However, it also has to be pointed out that during the "EuroSea years" specific support could be given to the EuroGOOS TT's and that help very much the development and overcoming known gaps (e.g. Best Practices convergence process, Data/metadata initiatives, costs for virtual/in person meetings). Obviously, this sporadic support is not a model for something that is expected to (and in reality,

also does) address sustained needs. In this context, it shall be emphasized that the funding to the networks from EuroSea WP3 was very little, only a few 10k Euros for each network.